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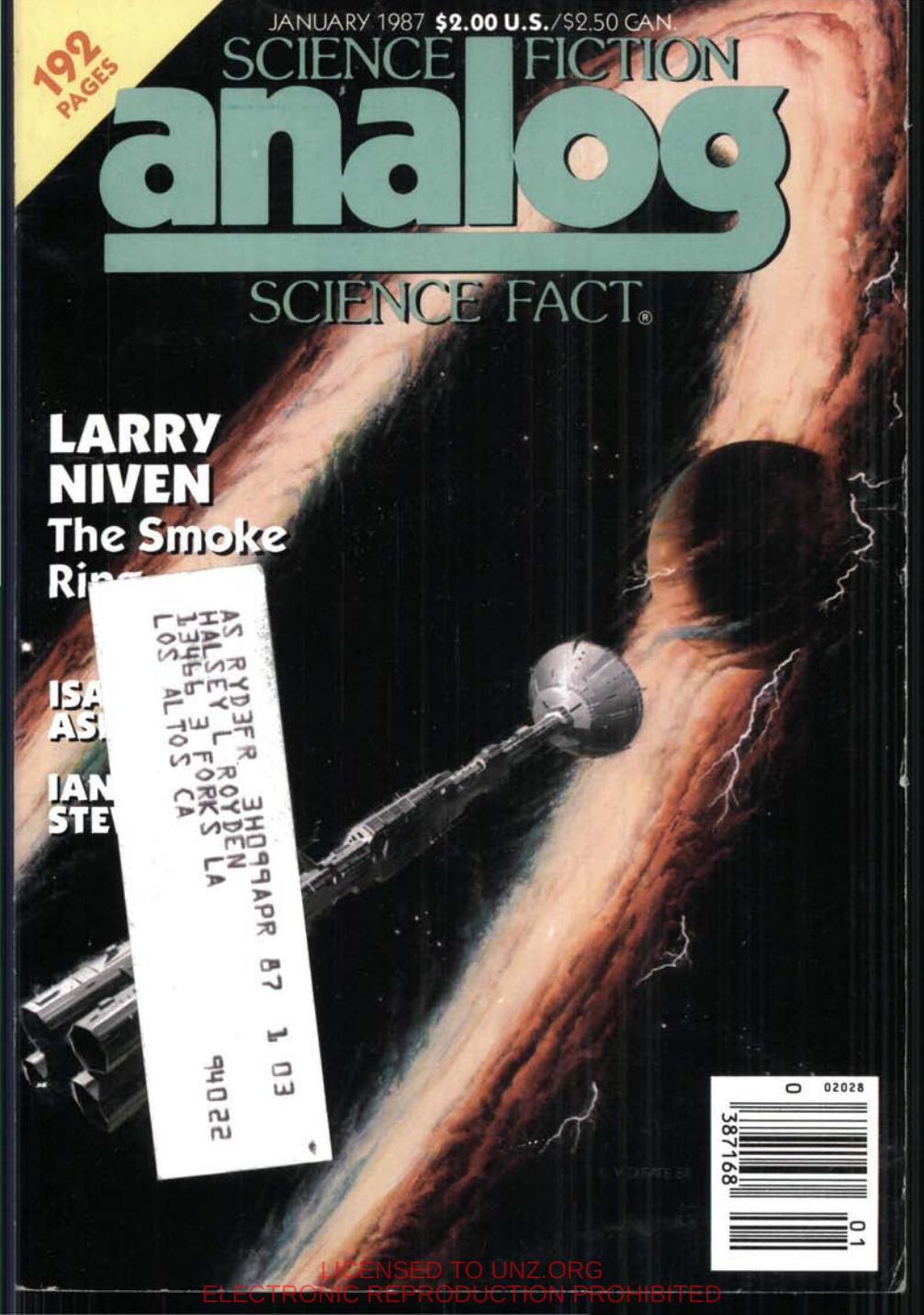

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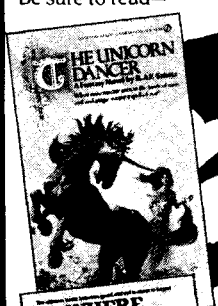

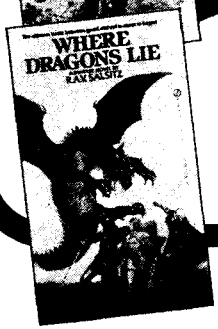

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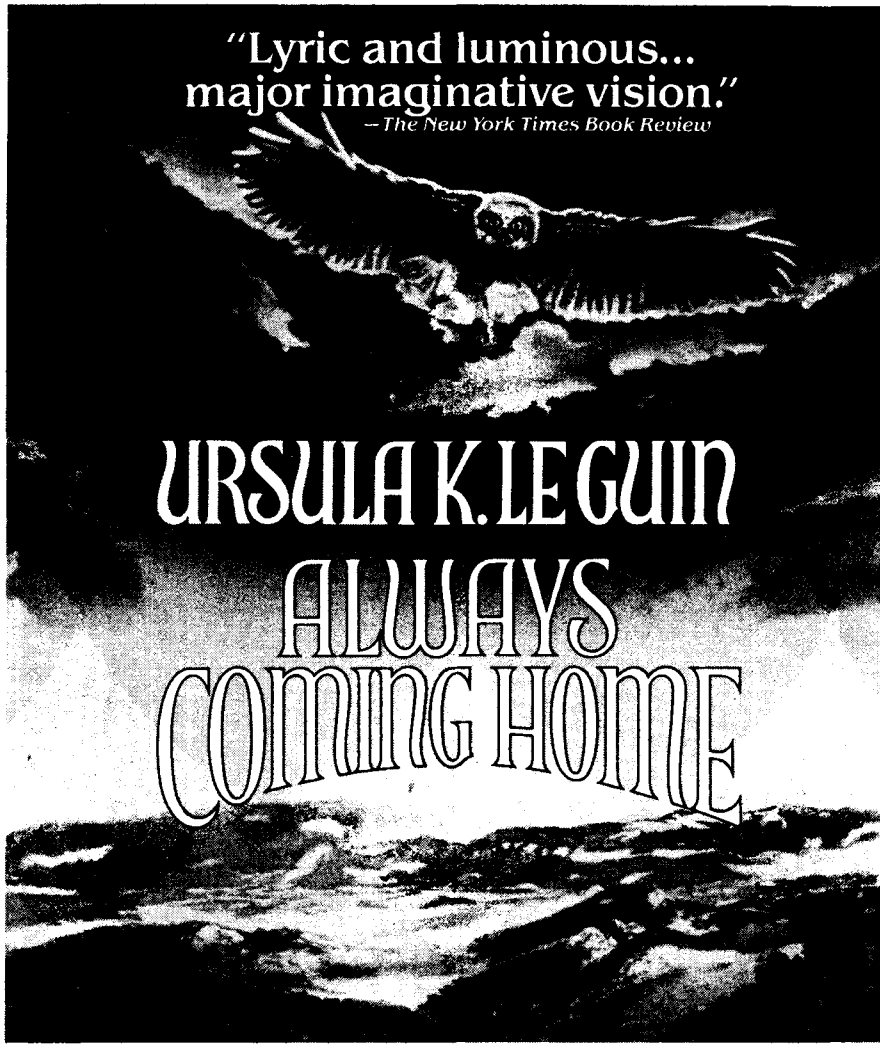

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Editorial

FUNDAMENTAL DILEMMA

Stanley Schmidt

As expected, my July editorial "Unholy War" drew lots of heated mail, some of which you can read in this month's letter column. That editorial dealt with the recent small but noisy movement among antiabortionists using such aggressive tactics as bombing abortion clinics, and the tendency of some sympathetic law enforcement officials to tolerate or even encourage such behavior. It was *not* primarily about the morality of abortion itself, though some readers predictably reacted as if it were. It was about the morality and legality of these methods of protest, which I maintained were at least "rude" and in some cases illegal, and about the ethics of public officials deliberately ignoring the laws they were hired to enforce. In discussing those issues, it was necessary to touch on the peculiar nature of the evidence with which both "pro-life" and "pro-choice" advocates justify their positions; but my main goal was not to defend or attack either position as such. Some readers recognized that and saw past the "trigger words" to what my real point was. I was delighted that some of them brought into the open some disturbing questions that were implicit in the whole discussion, and it is to those that I return today.

Before I get into that, let's make one thing very clear. *This editorial is not about abortion.* Please read that sentence three times, slowly, and keep it in mind for the duration. If at any point you think it *is* about abortion, you're missing the point. Please try again.

OK. Now that that's out of the way, we can get down to business. The in-

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teresting and important question several readers raised refers to the fact that I objected to some of the protesters' tactics, and to officials' tolerance of those tactics, *on grounds of illegality*. In particular I pointed out that, like it or not, abortion is now legal, and policemen and judges are employed to enforce the law as it is, not as they would like it to be.

To which some readers quite rightly replied that "legal" and "moral" do not always coincide, and that some of the things now generally regarded as history's great social advances were achieved only by violation of existing laws, while some of history's greatest atrocities were fully and undeniably legal. I agree completely, and in fact consider the point so important that I will not only pass on some of my correspondents' examples, but add a couple of my own.

I started writing this on July 4 (in the middle of a lavish "Liberty Weekend" that ironically fell at a time when the pendulum of history seemed well into a swing toward more restraints on personal liberty). Despite my parenthetical comment, the American experiment seems to me one of the most worthwhile and, on the whole, successful in recorded history. What happened on July 4, 1776 has led to a truly monumental series of achievements. The way has not always been smooth and the record is far from perfect, but the real accomplishments are of such magnitude and importance as to overshadow quite a few shortcomings. Perhaps the anniversary of its signing is an appropriate time to

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reflect that the Declaration of Independence and the armed rebellion that followed violated the letter and spirit of existing law about as flagrantly as anything could. If the Revolutionists had lost, George Washington and Thomas Jefferson and all the others would be remembered not as heroes but as criminals and traitors. In the strictly legal sense, they were—and I'm glad they did what they did.

In the next century, this country was divided by a controversy over black human beings who were held as slaves. Their status was legally tested and clarified: slaveholders were fully protected by law, and abolitionists who smuggled slaves north to freedom via the "Underground Railroad" were unequivocally criminals. So were those who helped Jews hide from Nazis in Hitler's Germany—while the mass murderers

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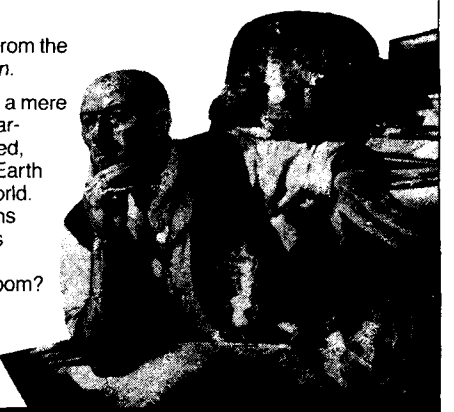

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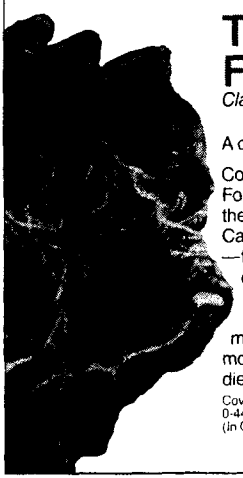

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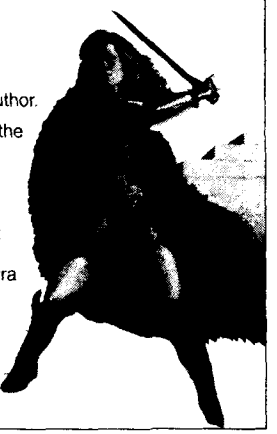

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who ran the ovens at Dachau and Oświęcim were law-abiding citizens.

Those few examples should be enough to shake anyone's faith in a simple correlation between "law-abiding" and "virtuous." Once his faith is so shaken, how is a person to decide when laws should be obeyed and enforced, and when they should not?

That question, it seems to me, represents a truly fundamental dilemma which lies at the very heart of the concept of civilization. Every civilization and every human being must find his or its own answer, and I grow increasingly doubtful that there is ever a nice simple answer everybody can be comfortable with.

One simple answer that might be proposed is that every man or woman must follow his own conscience, whatever the law may be. Sounds good—but the inevitable consequences of that kind of thinking are what made laws necessary in the first place. Consciences are highly individual things: what one man sees as purifying civilization in a holy cause, another sees as cold-blooded murder —*and they both sincerely believe they're right*. One of the few legitimate functions of government, as I see it, is to protect individuals from others whose ideas of right and wrong allow injury to their fellows. Most modern governments exercise that function at least in part by establishing laws which spell out what kinds of behavior will and will not be tolerated, and enforcing those laws by punishing violations. Consistent enforcement is an essential part of the process, because without it laws are just meaningless words. Some readers said that if human judgment is not allowed to intervene and make exceptions, the result is a "cold and mechanical justice," or words to that effect. No doubt there is some truth in that, which is one reason courts have judges and juries. But history provides plenty of hair-raising examples of the other extreme, where individuals ruled by whim without constraint by law. They are why "a government of laws, not of men" has come to be widely regarded as a civilized ideal.

On the other hand, laws are *made* by men, and men can make bad laws. A society in which bad laws are blindly obeyed can be just as nightmarishly destructive and inhumane as one in which a ruthless tyrant can carry out bloodthirsty whims with impunity. Herr Hitler demonstrated that very dramatically, and other examples abound.

Those are extreme cases; most of us live in cultures where some laws are more beneficial than harmful and others are just the reverse. So what is a person to do—obey (and, if he is an official, enforce) the ones he likes, and ignore or try to get around the ones he doesn't?

Actually, some version of that is eminently defensible, if it's really thought out. If you haven't read the discussion of "rational anarchism" in Chapter 6 of Robert A. Heinlein's *The Moon Is a Harsh Mistress*, I strongly recommend that you do so—and think about it.

What they taught us in school, as I recall, was that a Good Citizen obeys the law as it is and works within the

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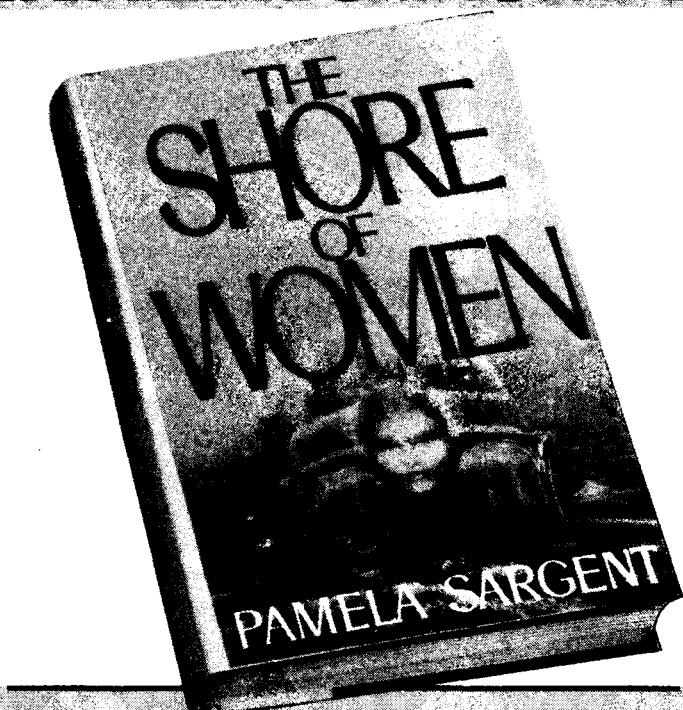

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system to change the parts he thinks need improving. Like so many other things, that sounds good on paper and sometimes even works—but sometimes, in practice, it leads only to frustration. The American Revolution, the Underground Railroad, the increasingly turbulent demonstrations against the Viet Nam War, the anti-abortion protests at the fringes of legality—all of these things have happened because people who wanted to change things found that working within the system *wasn't working*. Having tried to get what they wanted through more accepted political channels, and failed to make what they considered significant progress in a reasonable time, they turned to other methods. Which, on at least one level, is a perfectly sound engineering approach: if Method A (as in the instruction book) doesn't work, try Method B.

But it's not so good for people who *do* like the way things are and have a reasonable expectation that the law will help keep them that way.

Fundamental dilemma: On the one hand, laws exist to protect people from each other, and people have a right to expect the kind of protection promised by the law. On the other hand, one man's protection is another's oppression, and it seems a perversion of good character for a man of strong principle to follow or even tolerate a law which seems clearly immoral.

Schools, in my experience, have seldom faced this dilemma squarely. "Be a good citizen," they told us, "and obey the law." And then they told us, "Follow your conscience: always do what you know is right."

They never told us you can't have it both ways—but you can't, unless you have that peculiar kind of "conscience" than can honestly believe your leaders are always right, no matter what. Anyone with a *real* conscience—anyone who's actually thought about what he considers moral or ethical—is sooner or later going to find his thinking in conflict with prevailing law.

When that happens, he's going to have to decide what to do.

I offer no easy answer. I don't think there are any. The fundamental dilemma is *so* fundamental to the whole idea of civilized conduct that it will always be with us.

The best I can say is that, in the long run, that may not be so bad. In fact, the fundmental dilemma and the ways people deal with it might be viewed as an integral part of the *real* government under which we live (the "official" government being another part).

The official government has built into it a system of checks and balances. The U.S. federal government, for example, has three branches—legislative, executive, and judicial—each of which can modify and curb actions of the others. If the President doesn't like a law passed by Congress, he can veto it. Congress may revise it to get his approval, but if enough members feel strongly enough, they can override his veto. The courts can invalidate a law passed by Congress and the President by finding it unconstitutional. If that bothers Congress enough, it can change the Constitution.

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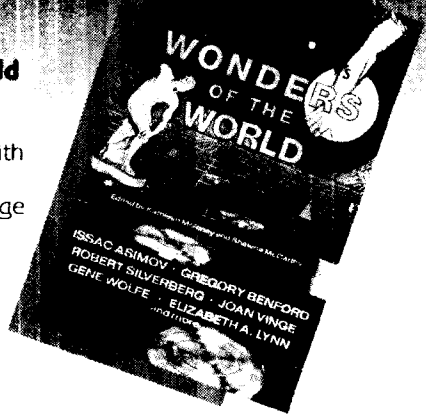

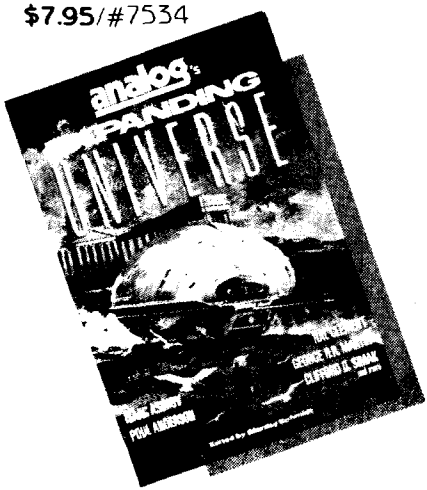

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And so on.

The "fundamental dilemma," it seems to me, is an informal extension of the system of checks and balances through which concerned citizens exert direct influence on the direction of law and society. The people hire a government to exert certain controls on their own members—but they will not accept just *any* controls. Left to its own devices, the official government will churn out and enforce a steadily evolving body of law. Sometimes, even with checks and balances within the official government, some portion of that body of law will get seriously out of tune with the perceived needs of at least some of the people living under it. If the mistuning gets bad enough, some of the aggrieved will rebel against the offending laws—and, depending on a variety of factors including how much of the population sympathizes with the protesters, they may eventually force some change.

Viewed that way, this "extracurricular check" is probably a useful thing, and historically it has been an integral part of the evolution of law and custom. But for checks and balances to be effective, the factions involved must always try to carry out their *own* roles to the best of their ability. The dynamism which makes the system work results from an interaction which is at least partly adversarial, and it's seriously weakened if judges try to act like legislators or legislators try to outguess judges. Each branch exists not to keep the others happy, but to keep them in line.

So is it with the official government and the people, the collaborator/ adversaries in this last check-and-balance relationship. The government is hired to define and enforce limits on individuals; it cannot carry out its function unless it actually and consistently enforces the laws it has made. The people cannot expect good government unless they insist on it, actively opposing laws that they find intolerable until those laws are changed—by campaigning and voting, if possible; by means that risk jail, if necessary.

That is why there will never be a utopia. People differ, and people change. When what I've called an expanded system of checks and balances is operating optimally, law enforcement agencies enforce laws, some of which are less than ideal; and citizens break laws, when they have found those laws unacceptable and have exhausted other means to change them.

And that, I suspect, is the best we can hope for as an answer to the fundamental dilemma. Not entirely satisfying, perhaps—but the alternatives, whether obeying or ignoring laws indiscriminately, are worse. Civilization can afford neither governments which allow some people to do whatever they choose, nor citizens who blindly follow whatever is put forth as law. ■

● The most dangerous thing in the world is to leap a chasm in two jumps.

David Lloyd George

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Before the Big Bang: News from the Hubble Large Space Telescope

by JONATHAN V. POST

The Astronomer was red-eyed, pale,
his face was gray with stubble;
he was 13 on a sliding scale
of 1 to 10 in trouble.

"Is Physics just a fairy tale?"
he asked, and then began to wail,
"Why DID we seek the holy grail?
Why DID we launch the Hubble?

The launch was good (relax, exhale)
the data systems did not fail
we peered beyond the cosmic veil,
the anti-cosmic double

to back before the quarks prevail.
We digitized each dark detail
but it was all to no avail,
it burst our pretty bubble."

"WHAT did you see?" I asked "Before
Beginning's Big Bang lights?"
(I reviews and interviews. I edits and I writes.)
"Before the start of Time, before the Universe's Birth,
What DID the Hubble show, ten billion years before the Earth?"
He told me. Now I writes no more.
I drinks a bit. I edits.
"Right before the Beginning," he said,
"is when THEY roll the credits!"

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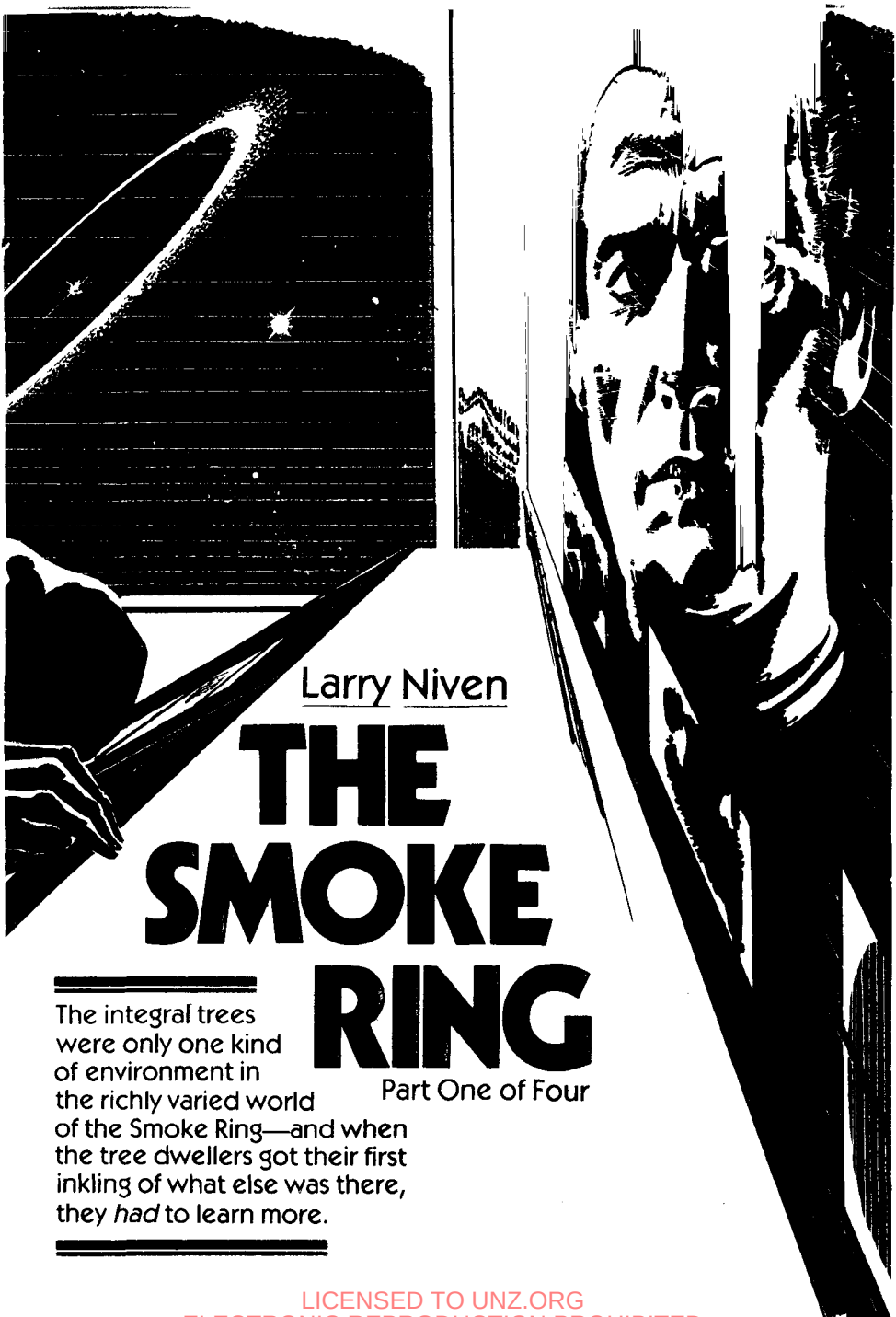

Larry Niven

THE SMOKE RING

Part One of Four

The integral trees were only one kind of environment in the richly varied world of the Smoke Ring—and when the tree dwellers got their first inkling of what else was there, they *had* to learn more.

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Prologue: *Discipline*

The planet below him was hidden to all of Sharls's senses save for the neutrino screen, the neudar. What had been a gas giant planet a billion years ago was still a world two and half times the size of the Earth: an egg of rock and nickel-iron hidden in world-sized storms. The storms spread out into a cloudy ring occupying the entirety of Goldblatt's World's orbit around the neutron star.

Sharls watched storms spin outward from the gas giant. Streams of fog and cloud and dust ran slow near the Smoke Ring's outer rim, faster at the Smoke Ring median, faster yet as they neared Levoy's Star; and everywhere there were flattened whorls of hurricane. The gravity gradient was savage this near the ancient neutron star. The innermost limits of the Smoke Ring circled Levoy's Star every two hours.

The Smoke Ring was tinged with green—it had its own billion-year-old ecology—and somewhere in that cloud were men.

The temptation to go to them was a constant low-level irritant.

When moving between stars *Discipline* burned the near-infinite hydrogen of interstellar space; but *Discipline* had been at rest for a long time now, and onboard fuel was limited. Refueling could not have progressed far when the mutiny came. Sharls's supply of deuterium-tritium mix was finite. He had no way of knowing how long he must wait for the children of *Discipline*'s crew to rediscover civilization, to build their own spacecraft, to come to him. He was always short of power. The solar collectors on his two remaining CARMs didn't give him much.

Sharls ignored the stars, most of the time. He watched the Smoke Ring. When the boredom become too much for him, he edited it from his memory. Boredom was a recurring surprise.

Five hundred and thirty-two Earth years was one hundred and ninety-two orbits of Levoy's Star round its companion star. But the natives of the Smoke Ring measured years from the passings of the neutron star (Levoy's Star, "Voy") across the face of the yellow dwarf (T3, "Sun"); so a Smoke Ring "year" was 1.385 Earth years. Sharls had been waiting in the L2 point behind Goldblatt's World for three hundred and eighty-four Smoke Ring years.

Best to sit it out in a stable orbit, and watch, and wait for men to develop civilization. Best to edit the memory of boredom. . . .

Discipline's computer/autopilot stored its information as a human brain did, or a hologram; though Sharls could feel differences. Memories from his time aboard *Discipline* were sharp and vivid. Those he had edited were gone completely. But memories from his time as a man, transferred long ago from a human brain now long dead, were blurred, hard to retrieve.

So: it wasn't like a relay clicking over.

But somewhere in the computer there was a change of state. Five hundred and thirty-two years, and *enough is enough*. Sharls Davis Kendy was done with waiting.

SECTION ONE: CITIZENS TREE

Chapter One: The Pond

From the Citizens Tree cassettes, year 19 SM:

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PONDS

Water droplets come in all sizes here. Clouds may hold everything from fine mist, to globules the size of a fist, to spheroids that house all manner of life. The biggest "pond" we've seen massed ten million metric tons or so; but the tide from Levoy's Star had pulled it into two lobes and the differential winds were tearing it apart.

The ecology of the ponds is one rather than many. Life is queer and wonderful, but in every pond we have examined it is the same life. Ponds are temporary; pond life must occasionally migrate. In the Smoke Ring even the fish can fly.

—Carol Burnes, Life Support

Lawri and Jeffer swam beneath murky pondwater, trailing forty square meters of fabric stretched across the net more commonly used to sieve harebrains from the sky. They gripped its corners in strong toes and swam with their arms.

The sheet resisted. The leading edge tried to crumple. Tethers at the corners of the harebrain net got in their way. *We could have had some help,* Jeffer thought. *Lawri wouldn't have it. Lawri's idea, Lawri's project! She'd be doing this by herself if she possibly could.*

Air! He slapped her thigh. She dropped the sheet and they swam toward the light.

Air is the sweetest taste, though one must risk drowning to appreciate it.

They were at the arc of the pond nearest Citizens Tree. The center of the trunk was a mere three klomters east. Seventy klomters of trunk ran out and in from the pond, ending in paired curved tufts. The in *home,* tuft, looked greenish-black, with Voy's blue pinpoint shining almost behind it. A single line ran from the trunk, and divided.

The sheet was a ghostly shadow deep within the pond. Lines ran from the corners, up through the water and out, to join the main cable that ran to the trunk.

"Almost in place," Lawri said doubtfully.

"Close enough."

"All right. You go get the carm ready. I'll draft some hands to pull it in."

Jeffer nodded. His legs scissored and shot him into the air. He drifted toward the main cable in a spray of droplets.

It was easier than arguing. Lawri would not leave Jeffer to organize the final stage. When Lawri the Scientist got an idea, nobody else got credit. Particularly not Citizens Tree's other Scientist, her husband.

Partway around the curve of the pond, Minya and Gavving floated in the interface between air and water, surrounded by thrashing children.

Lines ran from each child toward the cable from Citizens Tree. The children were taught the backstroke first. It kept their faces in the air. Some preferred the frog-kick that let them look beneath the water. Swimming was a balance of surface tension versus the thrust of arms and legs.

If a child kicked himself entirely out of the water, an adult must go after him. A child who went beneath the surface could panic and must be pulled out before he drowned. There were carnivores among the water-birds. Minya and

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Gavving wore harpoons. They had three of their own among the swimmers.

Gavving used lazy strokes to change his attitude, moving his field of view in a clockwise circle.

"Look at Rather," Minya said.

The oldest of the children were swimming together. Daughter of two jungle giants, golden-blond Jill had grown to merely normal height in the tide of Citizen's Tree. She was nearly a meter shorter than her parents . . . but the contrast between Jill and Rather was startling. At fourteen, Minya's dark-haired firstborn son was less than two meters in height. Jill had more than half a meter on him.

Yet Minya never spoke of Rather's height. Gavving looked again and said, "Right. *Rather!*"

Rather paddled over, reluctantly. Fine green fur, barely visible, grew a mi'meter long on his left cheek. Gavving gripped the boy's arm and lifted him partway out of the water, against surface tension. The green could be traced down Rather's neck, over his shoulder, and partway across his chest.

"Fluff," Gavving said. "Why didn't you tell someone?"

Rather grinned guiltily. "I've never swum before."

Minya snapped, "You go straight—"

"No. Finish your swim. You'll pay for it. You've seen your last of the sun for awhile. Have we raised a fool? It's almost reached your eye!"

Rather nodded solemnly and paddled away. Minya watched him go, her mouth pursed in anger. Her husband wriggled and was silently underwater; kicked, and was beneath her; grasped an ankle and dove. Minya doubled back on herself and kicked him across the jaw. Gavving reached through the defense of her waving arms and legs and had her head between his hands; pulled her to him by main strength and kissed her hard. She laughed bubbles.

He kicked toward the surface with Minya in tow. They blew water from their faces before they inhaled, and were back on duty before any child could get into trouble.

Debby was some distance from where the children swam. She stayed just under the surface, motionless, peering, her spear poised. She expelled stale air—which stayed before her face as a bubble—raised her head, snatched a breath, ducked again.

Debby had lived her first nineteen years in free fall. Fourteen years in the tree-tide had put muscle on her without shrinking her height. Her children—and Ilsa's, the children they had borne to Anthon—were no taller than ordinary tree-dwellers. But Debby was two and a half meters tall. Her fingers were long and fragile; her toes were sturdier if less agile, and the big toes measured six ce'meters. Her rich brown hair was beginning to show gray, but she still wore it a meter long. For swimming she wore it looped in a braid around her throat.

The water was murky. This was a new skill for Debby, but she was learning.

She struck. The ripple of her thrust expanded outward around the great globule, past playing children and the Scientists working their cloth sheet.

A silver shape wriggled on Debby's spearpoint. Debby reached above her head, tugged hard at the tether, and

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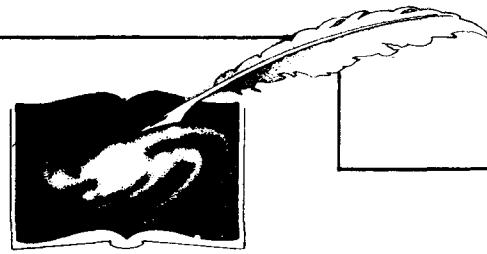

About L. RON HUBBARD's

Writers of the Future Contest

by Algis Budrys

The Writers of the Future contest substantially rewards at least twelve talented new speculative fiction writers each year. With no strings, every three months it confers prizes of $500, $750 and $1,000 for short stories or novelettes. In addition, there's an annual Master Prize of $4,000. All awards are symbolized by trophies or framed certificates, so there's something for the mantelpiece too.

There's also a Writers of the Future anthology, which I edit. (There was one last year, and there's another one just out as you read this.) It offers top rates for limited rights in the stories. These payments are in addition to any contest winnings. The anthology is distributed through top paperback book retailers everywhere, and is kept in print and on sale continually. All that's required to win or to be a finalist is a good new story, any kind of fantasy or science fiction, no more than 17,000 words long, by writers whose published fiction has been no more than three short stories or one novelette. Entry is free.

The contest deadlines in 1986 are March 31, June 30, and September 30, and there are First, Second and Third prizes for each three-month quarter. At the end of our year, a separate panel of judges awards a Master Prize to the best of the four quarterly winners. So one person will win a total of $5,000. Judging panels include or have included Gregory Benford, Stephen Goldin, Frank Herbert, Anne McCaffrey, C.L. Moore, Larry Niven, Frederik Pohl, Robert Silverberg, Theodore Sturgeon, Jack Williamson, Gene Wolfe and Roger Zelazny, as well as me. Matters are administered so that the judges are totally independent and have the final say.

It seems hardly necessary to embellish the above facts with any enthusiastic adjectives. This contest was created and sponsored by L. Ron Hubbard and the project will continue in 1986 and try to do some realistic good for people whose talent earns them this consideration. For complete entry rules, and answers to any questions you might have, write to the address given below:

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Or, you can find the rules—and examples of winning stories, plus informative essays by some of the judges—in either of the Writers of the Future anthologies. They're original paperbacks and cost $3.95 each.

Good luck.

—Algis Budrys

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gasped as her head broke the surface. The water-bird, suddenly thrust into air, expanded its small wings and thrashed mightily. A blow to the head-end quieted it. Debby pushed it into a net bag to join five others.

Her chest still heaved with the need for air. She rested quietly on her back, her hands fluttering from time to time to keep surface tension from pulling her under.

Eastward, a thousand klomters past Citizens Tree, the cloud-patterns thickened into a flattened, frozen whirlpool. The Smoke Ring converged beyond and below the whorl in a stream of white touched with blue-green, narrowing as it dropped toward the dazzling point of Voy.

Things tended to collect in that special part of the Smoke Ring, east of Gold by sixty degrees of arc. The citizens had reason to know that the storm-whorl around Gold was dangerous. They assumed that the Clump was, too. They had never taken the tree nearer than this.

They had never visited a jungle.

Human beings certainly lived elsewhere in the Smoke Ring, but Citizens Tree had never attempted to contact them.

Citizens Tree was placid, safe. Working within the pond was as much excitement as Debby ever got these days. Life in Carther States had been different. The occasional raids from London Tree forced the citizens to be always prepared for war, until in one magnificent raid they had ended London Tree's power forever.

Debby's connection with the jungle warriors had ended too. A mixed group of copsiks and warriors had stolen London Tree's carm. The vehicle was old science, powerful and unfamiliar. They and their prisoners had been lucky to bring the carm to any kind of safety; but Carther States was lost somewhere in the sky beyond Gold.

From westward came a cheerful cry. "Citizens! We need muscle!" Debby saw Lawri the Scientist floating in the sky with one hand on the main tether.

Debby snatched at the net bag (six was a nice day's catch), kicked herself into the sky, and began reeling her line in. She was first to reach the Scientist. Clave and Minya and Mark the Silver Man were leaving the pond, reeling in lines. Gavving had stayed to gather the children.

Four tethers led to the corners of the sheet-covered net, which was now deep underwater. Lawri stationed them along the main tether as they arrived. "Gather it in," she directed them. "Make loops. Steady pull."

Debby wrapped her toes and her fingers around the cable, and did her savage best to contract her body. No loop formed. She knew she wasn't as strong as a tree-dweller, but the others were having trouble too.

Lawri called, "Good! It's coming straight out."

That was not obvious to Debby. She strained . . . and gradually the pond bulged. The sheet and its net backing were rising, carrying tons of water. Debby pulled until her knees and elbows met, then shifted her grip and continued pulling.

The pond stretched, and tore. A baby pond pulled clear, leaving a trail of droplets the size of a man's head. Water flowed over the edges of the cloth, but

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was not lost, for surface tension held it. The main pond pulsed as surface tension tried to form the sphere again.

"Keep pulling!" Lawri shouted. "Steady . . . okay. That should do it."

The citizens relaxed. The bud-pond continued to move east on its own momentum, toward the tree, with the net and sheet now in the middle of a pulsing sphere.

Debby coiled line that was now slack. Glancing toward the trunk, she saw what the curve of the pond had hidden earlier.

Parallel to the trunk and many klomters beyond it floated a slender dark line. A young tree, no more than thirty klomters long, and injured; for the in tuft was missing, chopped away somehow. The view was confusing, for the mid-trunk was wreathed in cloud . . . dark, dirty cloud . . . smoke!

Debby tugged abruptly at another line. The motion set her drifting toward the Chairman. Clave caught her ankle as she arrived. "Something?"

Debby pointed with her toes. "That tree. It's on fire!"

" . . . I believe you're right. Treefodder! It'll be coming apart. Two fires to worry about."

Debby had never seen a tree break in half, but Clave spoke from dreadful experience. They might have to move the tree. It would take time to get the carm ready—

Clave had already thought that far. His voice became a whipcrack roar. "Citizens, it's getting toward dinnertime, and we've got all these water birds. Let's break up the swim."

His voice dropped. "You go *now*, Debby. Tell Jeffer we may need the carm. We'll get the women and children down into the tuft, if we've got time. Your eyes are better than mine. Do you see anything leaving the tree? Like clouds of insects?"

There were black specks, big enough to show detail. "Not insects. Something bigger . . . three, four . . . birds?"

"Doesn't matter. Get going."

It had taken Jeffer the Scientist a fifth of a day to cross three klomters of line.

Free fall brought back memories. When Quinn Tribe was lost in the sky after Dalton-Quinn Tree came apart, his crew would have given eyes and limbs to reach a pond. Fourteen years later, the grandmother of all ponds floated three klomters from Citizens Tree; and now their main problem was to get rid of most of it. Jeffer wondered if the children appreciated their wealth.

Perhaps they did. Most of Citizens Tree, thirty naked adults and children, had come to swim in that shimmering sphere of water.

There was no foliage on the high trunk. It was thick rough bark, with fissures deep enough to hide a man. Jeffer found and donned his tunic and pants, then anchored his toes in a crevice and thrust to send himself gliding out along the bark, toward the carm.

The lift cable ended two hundred meters short of the carm's dock. The citizens may have feared that careless use of the carm might spray fire across a rising cage. More likely, they feared the carm itself. They would not lightly come too near that ancient scientific thing.

The carm was old science. It was roughly brick-shaped, four meters by

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ten by thirty-two, and made of starstuff: metal and glass and plastic, sheathed with darkly luminous stuff that took the energy from sunlight. The bulk of it was tanks for hydrogen and oxygen and water. Nostrils at the aft end—four at each corner, and a larger one in the middle—would spurt blue fire on command.

They had neglected the carm of late, and Jeffer accepted some of the blame. The carm made two "flavors" of fuel out of water and the power in the batteries. The batteries held their full scientific charge—they filled themselves, somehow, as long as sunlight could reach the carm's glassy surface—but the hydrogen and oxygen tanks were almost empty. It was high time they filled the water tank.

The carm's bow was moored in a dock of wooden beams. Double doors led into a hut with cradles for passengers, moorings for cargo, and a broad transparent window. The window looked forth on nothing but bark. Ventral to the window was a gray sheet of glass and a row of colored buttons.

Jeffer went forward. A touch of a blue button lit the gray glass panel. Blue governed what moved the carm: the motors, the two flavors of fuel supply, the water tank, fuel flow. Jeffer read the blue script:

H_2: 0,518
O_2: 0,360
H_2O: 0,001
POWER: 8,872

The batteries danced with energy. Why not? The carm wasn't using power. Nobody in Citizens Tree had bothered to fill the water tank in seven years; so power wasn't needed to split water into hydrogen and oxygen. The water tank was virtually dry.

And he could get something done while he waited for Lawri's pond. Jeffer touched the blue button (the panel went blank) and the yellow (there appeared a line diagram of the carm's bow, the hut section). He touched a yellow dot in the image, and turned his fingertip. Then he moved aft.

The residual goop in pond water stayed in the tank after the pure water was gone. Jeffer's finger-motions had (magically, *scientifically*) caused a spigot in the aft wall to ooze brown mud. He cupped the globule in his hands. He tossed it at the airlock, and most of it got through. Another globule formed, and he sent it after the first. He wiped his hands on his tunic. The mud flow had stopped.

Next he pulled several loops of hose from cargo hooks. He rotated one end onto the spigot, then tossed the coil through the twin doors. Done! When Lawri's bulb of pond arrived, she would find the carm ready to be fueled.

Jeffer returned to the controls. He had a surprise for his wife.

Two sleeps ago, while the rest of the tribe was roasting water-birds from the pond, Lawri had held one of the creatures up for his perusal. "Have you ever really looked at these?"

Jeffer had seen water-birds before . . . but he'd kept his mouth shut, and looked.

There were no feathers. The modified trilateral symmetry common to Smoke Ring life expressed itself in two wings and a tailfin, all in smooth membrane on collapsible ribs. The wings could be held half-collapsed for motion within

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the denser medium of water. Only one of the three eyes looked like a normal bird's eye. The others were big and bulbous, with large pupils and thick lids. The bodies were slippery-smooth.

"I've eaten them, but . . . you're right. I've seen everything from mobies to triunes to flashers to drillbits, and they don't look like this. Earthlife doesn't either. Do you think it's so they can move through water?"

"I've tried looking them up in the cassettes," Lawri had said. "I tried *bird*. I tried *water* and *pond*. There's nothing."

Jeffer's next sleep had ended with a dream fading in his mind, leaving a single phrase. " . . . even the fish can fly."

He'd had to wait until now to try it.

He tapped yellow (the display vanished) then white (and got a tiny white rectangle at the dorsal-port corner). White read the cassettes; white summoned Voice. "Prikazyvat Voice," he said.

The voice of the carm was a throaty bass, as deep as Mark the dwarf's voice. "Ready, Jeffer the Scientist."

"Prikazyvat read *Fish*. Read it aloud."

The cassette was one that Jeffer had stolen from London Tree, but it was no different from Quinn Tribe's lost records of Smoke Ring life forms. As Voice spoke, print scrolled down the display screen: words recorded long ago by one of *Discipline*'s abandoned crew.

FISH

If the birds within the Smoke Ring resemble fish—legless, designed to move through air weightlessly, as a fish moves through water—then the fish that live within the ponds resemble birds.

Every fish we have examined breathes air. They are not mammals, but lungfish. The single class of exceptions, *gillfish*, are discussed elsewhere.

Some can extrude a tube to the pond's surface. A few can expand the size of their fins via membranes, to make them a little more like wings. One form, *core fish*, inflates itself with air, dives to the center of a pond, and expels a bubble. It can stay submerged for up to a day—several Smoke Ring days—rebreathing its air bubble, making forays to hunt and then returning.

The whale-sized *moby* uses its pond as a lair from which it bursts to sweep through passing clouds of insects. *Moby* is a compromise form, and there are others.

Clearly even the largest ponds can break up or evaporate or be torn apart by storm. Every creature that lives in a pond must be prepared to migrate to another: to behave like a bird. Even gillfish—

"Prikazyvat Stop," Jeffer said. This memory that had surfaced from his adolescent training under Quinn Tribe's Scientist was going to put him one up on his wife!

Back to work. He tapped white, then green, then each of the five green rectangles now onscreen. Within the great window that faced the bark, five smaller windows appeared, looking starboard, port, dorsal, ventral, and aft. The ventral view had a blur and a flicker to it. The rest were clear, like the window itself.

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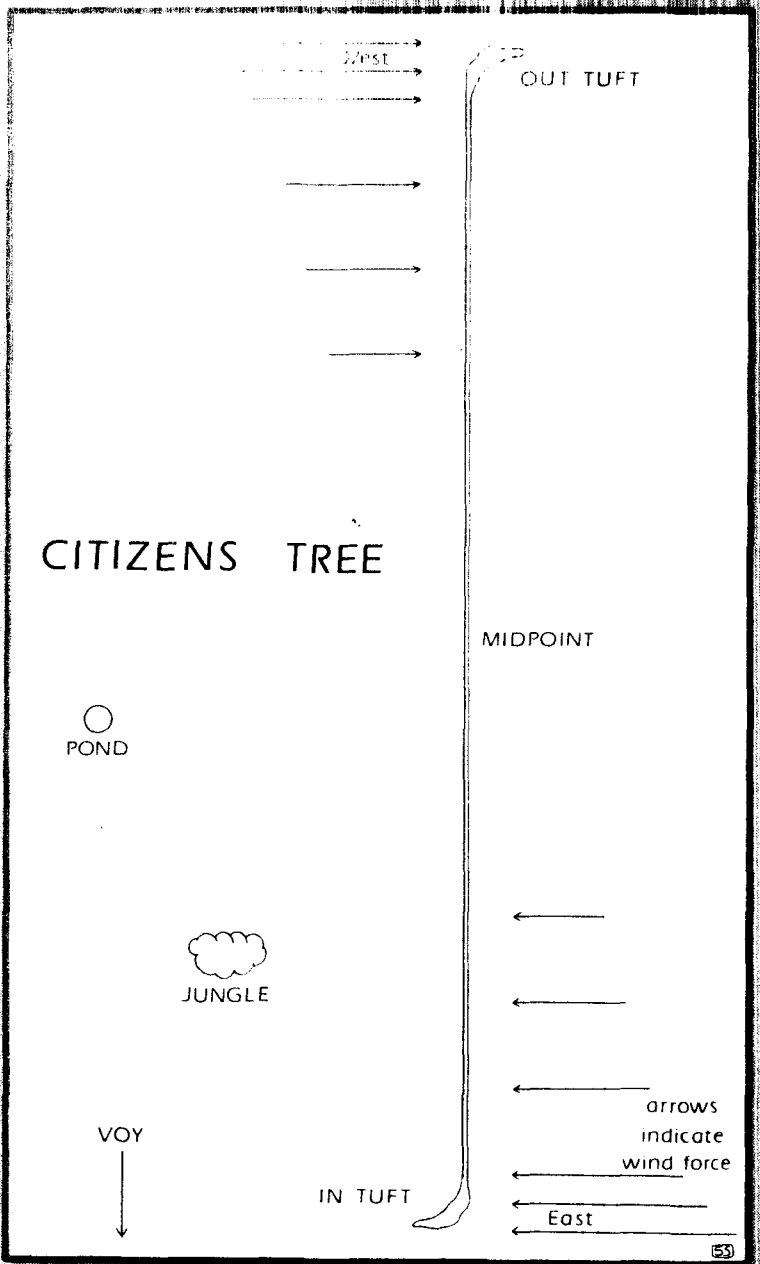

Diagram by Shelly Shacket

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The aft view looked along the line that led west to the pond. Citizens were returning to the tree. Behind them a bud of pond was already drifting toward the tree, with the harebrain net showing as a shadow within. Lawri's crazy idea was working.

They swarmed back along the cable toward the midpoint of Citizens Tree. Gavving and Minya and Anthon hung back, counting heads to be sure that all children were accounted for. A girl lost her grip and drifted; she was chortling and trying to swim through the air when Anthon scooped her up.

As children arrived, Clave herded the smaller ones, with some difficulty, into a rectangular frame with a slatted floor: the lift cage. He stopped when twelve children were inside. Leave room for a couple of adults.

The rest clung to the rough bark or floated like balloons on their tethers. There were wrestling matches. Eight-year-old Arth was getting good at using the recoil of his opponent's line. He was Clave's youngest, and just beginning the tremendous growth of adolescence.

Debby had arrived first. Clave could see her a hundred meters out along the bark, climbing toward the carm.

The pond-bud continued to move. Lawri wore a proprietory smile. Still, Citizens Tree had better have more line next time they tried this. The pond was too close. If the tree had brushed it there would have been a flood. They'd needed almost every meter of the klomters of line that Anthon had procured from a spaghetti jungle, years ago.

The lift now held a score of children. Whoever was in the treadmill would have a problem braking that weight. It couldn't be helped. He looked about. Mark and Anthon looked ludicrous together, Mark short and wide, Anthon long and narrow, their heads pointing in opposite directions . . . He called, "Anthon, Mark. Take the children down and bring back any adult you can find. Be prepared to fight a fire."

Anthon stared in astonishment. "*Fire?*"

"Burning tree. It's around the other side of the trunk now. Go down and get some help. Rather—where on Earth is Rather?"

Mark pointed outward. "I didn't know any reason to stop them," he said defensively. "They won't fit in the lift this trip."

Clave cursed silently as he watched Rather and Jill clawing their way out along the bark. There was no tide to hurt them here. If they slipped, someone would go get them. But he could have used their help.

Jeffer couldn't guess how long it took him to realize that the background had changed. Behind the five camera views superimposed upon it, the window no longer showed bark a few ce'meters distant. It showed a huge face, strong, with massive bones: the brutal face of a dwarf.

Chapter Two: *Discipline*

From the Citizens Tree cassettes, year 6 SM:

FIRE

Making a cookfire in free fall is an excessively interesting experience if what you really want is dinner. It's

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taken me eight State years to perfect my technique.

The first lesson is that a flame doesn't rise in free fall. I learned that with a candle, when I was a cadet dreaming of strange worlds. If there's no wind (turn off the air feed) the candle flame seems to go out.

But it isn't out yet. There's wax vapor, and there's the air around it, and at the interface is an envelope of plasma where gas and oxygen interact. It can stay hot for minutes. Combustion continues at the interface. Wave the candle and pop! The flame is back.

In the case of a cookfire, the wood continues to char. Wait an hour, then blow on the coals with a bellows. The fire jumps to life and there go your eyebrows.

—Judd Quinn, Life Support

Discipline had been deteriorating.

Cameras outside the hull showed rainbow-hued scars from matter that had penetrated the electromagnetic ramscoop while *Discipline* was in flight. They also showed newer micrometeorite pocks. Sharls could ward off anything big enough to see coming by turning on those magnetic shields for a few seconds, but they ate power in great gulps.

One day he might regret even the little power he used to maintain the gardens and the cats.

Within the hull, time had discolored metal and plastic. The air was dust-free; metal was clean, but not recently polished. Many of the servomechs had worn out. All but a few of the crew cubicles were kept cold and dark and airless. Kitchen machinery was in storage, with power shut down. Some of the bedding had decayed. Water mattresses had been drained and stored.

Sharls kept the control room free of water vapor and almost cold enough to freeze carbon dioxide. He hoped that the computer and its extensions would survive longer in the cold. But the gardens and corridors and even some of the cubicles were kept habitable. Sharls left the lighting on a day-night cycle, for the birds and cats and plants.

The gardens were surviving nicely. It was true that some of the plants had died out completely; but after all, his ecosystem was missing its most important factor. Human crew were supposed to be in that cycle, and they had been gone for half a thousand years.

Scores of cats prowled the ship hunting hundreds of rats and a lesser number of turkeys and pigeons. The turkeys made a formidable enemy. The cats had learned to attack them in pairs.

Sharls trained the cats to respond to his voice. He had released the experimental rats long ago. The birds were already loose; they must have been released during that blank spot in his memory, the mutiny; but by themselves they wouldn't have fed the cats. They were too agile, for one thing. With all of the animal life in the system now, the gardens had a better chance of surviving.

By watching the cats and rats and plants and turkeys and pigeons interact, Sharls hoped to learn how an ecological system would behave in a free fall environment . . . like the larger ecosystem that flowed beneath *Discipline* in endless rivers of curdled cloud.

Or had he simply become lonely? In

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his youth Sharls had never been a cat lover. (A sudden memory: his hand swelling with white patches rimmed in red, itching horribly. A kitten had scratched him playfully while he was stroking it.) And now? They didn't obey orders worth a damn . . . but neither had his crew.

A computer program would hardly have retained allergies; but who would expect a computer program to become lonely?

Discipline skimmed above the curdled whorl of the fourth Lagrange point. A fraction of Sharls Davis Kendy's attention watched on various wavelengths. This close, he could confirm an earlier sighting: minor amounts of carbon were being burned at sites around the edges of that endless storm. This was no forest fire: too small, and it had gone on for years. It might indicate human industry at a primitive level.

Now, where was CARM #6?

. . . Funny, that the cats hadn't gone with the mutineers. The crew had loved cats. Somewhere in the lost part of his memory, there must be a reason. Perhaps Sharls had pulled free of the Smoke Ring without warning. He might have done that if the mutineers planned something really foul, like cutting the computer out and trying to run *Discipline* manually.

The mutiny was a blank to Sharls.

He had edited those memories. He even remembered why. The descendants of the mutineers would need Sharls Davis Kendy, someday. It was not good that he hold grudges against specific ancestors, against old names. But had he been *too* thorough?

—There! CARM #6's communications system had come alive.

It was a thousand kilometers behind him and something less than six thousand kilometers in toward Voy. Kendy did several things at once. Before his new orbit could carry him away, he restarted the drive. He beamed, "Kendy for the State. Kendy for the State."

The CARM autopilot responded.

"Link to me. Beam records."

He'd made mistakes enough during that unexpected contact twenty Earth years ago! At least he'd accomplished something: he'd broken the program that denied him access to the Cargo And Repair Module. The drive systems were beyond his reach. The original mutineers must have physically cut the fiber-optic cable. But the CARM would talk to him!

He'd instructed the autopilot to take photographs at ten minute intervals. Reentry was in progress when he sent that message. Static might well have fuzzed him out. But pictures were streaming in:

Time passed at a furious rate. CARM #6 flamed as it plowed through thickening air, veering from plants and ponds and creatures. It dipped into a pond to refuel, then bedded itself in the Voyward tuft of the largest of a cluster (grove?) of integral trees. It stayed there, with not much of a view at all, for most of a Smoke Ring year. Flickering shapes carved cavities through the foliage, and wove small branches into wasp's-nest structures. Abruptly the CARM backed into the sky, skittered outward under inexpert handling, and docked at the midpoint of the tree.

With another part of his mind, Kendy

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fiddled with *Discipline's* fusion motor. He could not match his orbit to that of the CARM. He must stay well outside the Smoke Ring to protect *Discipline* from corrosion. The best he could do was double the CARM's orbital period, to dip low above the CARM's position once every ten hours and eight minutes. But he'd be in range for half an hour while his motor was firing.

More of his attention went to watching the CARM's lone occupant in real time.

Jeffer the "Scientist" was stored in memory. He had aged twenty Earth years: hair and beard going gray, wrinkles across his forehead (broken by a white line of scar that was a healing pink wound in Kendy's records), and knuckles turning knobby. Height: 2.3 meters. Mass: 86 kilograms. Long arms and legs, toes like stubby fingers, fingers like a spider's legs: long, fragile, the hands of a field surgeon.

The Smoke Ring had altered *Discipline*'s descendants. The tribes of London Tree and Dalton-Quinn Tree had all looked like that. The jungle giants who had grown up without tidal gravity were hardly human: freakishly tall, with long, fragile, agile fingers and toes; and one of the twelve was a cripple, and others had legs of different length. Only Mark the Silver Man had looked like a normal State citizen. They had called him "dwarf."

They were savages; but they had learned to use State technology in the form of the CARM. Still human. Perhaps they could be made citizens again.

To Kendy, who thought with the speed of a computer, the "Scientist" moved much too slowly. Now he was at the controls, auditing a cassette; now checking the camera views in present time . . .

The incoming CARM records showed clouds and ponds and trees and trilaterally symmetric fishlike birds swirling across the sky. Natives flickered through the CARM cabin: the same savages, growing older; a growing handful of children.

At fifteen years minus-time the CARM backed out of its timber dock for a journey of exploration. It visited a green puffball several kilometers across, and when it emerged there was vegetation like a houseful of green spaghetti bound to its dorsal surface. It hovered in the open sky while men darted among a flock of birds—real birds with real wings: turkeys—and returned to its dock with prisoners.

At thirteen years minus-time it left the trunk to return with a dubious prize: several tons of black mud.

There were no more such forays. The Cargo and Repair Module had become a motor for the tree.

It was docked when the main drive fired for several hours. Kendy watched side views as the integral tree drifted across the sky. It had been circling too far from the neutron star. Air grew thin away from the Smoke Ring median.

The tree was lower now; the air would be as thick as mountain air on Earth. And now the CARM was not being used at all; but there was plenty to watch. The Smoke Ring environment was fascinating. Huge spheres of water, storms, jungles like tremendous puffs of green cotton candy.

In present time, the aft CARM camera showed nearly thirty natives maneu-

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vering between the tree and a tremendous globule of water. They were using the free fall environment better than any State astronaut. The State had need of these people!

Discipline's own telescope had found the foreshortened tree, with the pond to mark it. And what was that on the opposite side of the tree? Infrared light glowed near its center . . .

Half a thousand years of sensory deprivation were being compensated in a few minutes. After more than five hundred years Sharls Kendy had left the stable point behind Goldblatt's World. He had burned irreplaceable fuel, and it was worth it! Sharls tried to absorb it all, integrate it all . . . but that could wait. The "Scientist" might leave at any minute!

He beamed: "Interrupt records." It was twenty Earth years of nothing happening, and the tiny CARM autopilot couldn't handle too many tasks at once. "Activate voice."

"Voice on." The .04 second delay was almost too short to notice.

"Send—" He displayed a picture of himself as a human being, with minor improvements. At age forty-two Kendy had been handsome, healthy, mature, firm of jaw, authoritative: a recruitment-poster version of a State checker.

These were not obedient State citizens. They hadn't trusted him twenty years ago. What words might give him a handle on Jeffer the "Scientist"?

He sent, "Kendy for the State. Jeffer the Scientist, your citizens have been idle too long."

Jeffer jumped like a thief caught in the act. Two long seconds passed before he found his voice. "Checker?"

"Speaking. How stands your tribe?"

Out beyond the terrible whorl of storm that surrounded Gold, out where water boiled and froze at the same time and the legendary stars were a visible truth, lived Kendy the Checker. He had claimed to be something like an elaborate cassette: the recording of a man. He had claimed authority over every human being in the Smoke Ring. He had offered knowledge and power, while they were still near enough to hear his ravings.

Perhaps he was only a madman trapped somehow aboard the spacecraft that had brought men from the stars. But he had knowledge. He had coached them through that terrible fall back into the Smoke Ring, fourteen years ago.

The face in the carm's window had not been seen since. It was the face of a dwarf, a brutal throwback. The jaw and orbital ridges were more massive even than Mark's, the musculature more prominent.

"We lived through the re-entry." Jeffer told him. "Ilsa and Merril are dead now. There are children."

"Jeffer, your tribe has possessed the CARM for fourteen of your years. In that time you have moved the tree twice, and thenceforth done nothing at all. What have you learned of the people of the Fourth Lagrange Point?"

The what? "I don't understand the question."

"Sixty degrees ahead of Goldblatt's World on the arc of the Smoke Ring, and sixty degrees behind, are regions where matter grows dense. They are points of stability in Goldblatt's World's

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orbit. Material tends to collect there." The dwarf's brutal features registered impatience. "East of you by twelve hundred kilometers, a vast, sluggish, permanent storm."

"The Clump? You're saying there are *people* in the Clump."

"I sense activity there. A civilization is growing twelve hundred kilometers from where your tree has floated for fifteen Earth years. Jeffer, where is your curiosity? Has it been bred out of you?"

"What do you want from me, Checker?"

Kendy said, "I can be in range to advise you every ten hours and eight minutes, once every two of your days. I want to know more of the people of the Smoke Ring. In particular, I want to know about you and about the Clump civilization. I think you should link with them, perhaps rule them."

Jeffer's one previous experience indicated that Kendy was harmless. For good or ill, he could only talk. Jeffer gathered his courage and said, "Kendy, the tales say that you abandoned us here, long ago. Now I expect you're bored and—"

"I am."

"And you want to talk to someone. You also claim authority I won't grant you. Why should I listen?"

"Are you aware that you are being invaded?"

"What?"

The face of Kendy was suddenly replaced by a dizzying view. Jeffer looked into a river of storm, streaming faster as the eye moved inward toward a tiny, brilliant violet pinpoint. Jeffer had seen this once before: the Smoke Ring seen from outside.

Before he could remember to breathe, the view jumped. He was looking at what had been the center of the picture, vastly enlarged.

"Look." Scarlet arrowheads appeared, pointing— "Here, your tree."

"Citizens Tree, from the out tuft? Yeah, and that must be the pond." Both were tiny. Opposite the pond was . . . another tree? And a dark cloud clinging to the trunk?

The view jumped again. Through the blur and flicker in the illusion of a window, Jeffer watched a tree on fire. Moving between the two trees were creatures he had never seen before.

"Treefodder! Everybody's on the other side of the trunk. Those bird-things will be on the tree before anyone knows it."

"Look in infrared." The picture changed again, to red blobs on black. Jeffer couldn't tell what he was looking at. The scarlet arrowhead pointed again. "You are seeing heat. This is fire in the intruder tree. Here, these five points are just the temperature of a man."

Jeffer shook his head. "It doesn't mean anything."

The enlarged picture returned . . . and suddenly those tiny "creatures" jumped into perspective. "Winged men!"

"I would have called those enlarged swimming fins rather than wings. Never mind. Have you ever heard tales of winged men?"

"No. There's nothing in the cassettes either. I've got to do somethng about this. Prikazyvat Voice off." Jeffer made for the airlock without waiting to see the face fade. His citizens wouldn't have a chance against winged warriors!

The sun was at three o'clock: dead

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east, just above where the Smoke Ring began to take definite shape. *Kendy can only talk. Sure, but he talks with pictures, and he tells things nobody can know. He'll be in range every other day at this time. Do I want to know that?* But Jeffer had other concerns, and the rest of that thought lay curled unfinished in the bottom of his mind.

Jill was leaving Rather behind. She glanced back once and moved on, and there was laughter in the sound of her panting.

Jill was his elder by half a year. When he wanted company it was generally Jill he wanted; but they did compete. There had been a year during which she could beat him at wrestling, when she suddenly grew tall and he'd lagged behind. She'd taught him the rib lock the hard way: she'd held his floating ribs shut with her knees so that he couldn't breathe. He could wrestle her now—he was a boy *and* a dwarf—but her longer arms and legs gave her an unbeatable advantage at racing. He'd never catch her.

So he moved outward at his own pace, giving due care to his handholds and footholds in the rough bark, following the blond girl in the scarlet tunic. Her long-limbed mother had already reached the carm ahead of them.

At fourteen-plus, Rather was considered an adult. He was built wide and muscular, with heavy cheek, jaw, and orbital bones. His fingers were short and stubby, and his toes, though strong, were too short to be much use. His hair was black and curly like his mother's. His beard was sparse, without much curl to it yet. His eyes were green (and green tinged his cheek, with a growth of fluff that would be many days healing). He stood a meter and three-quarters tall.

Dwarf. Arms too short, legs too short. He should have gone around the trunk. Jill could have told the Scientist about the burning tree; Debby might already know. He could have been getting a closer look at the intruders!

The carm loomed ahead of him. It was as big . . . no, *bigger* than the Citizens Tree commons.

Debby shouted into the airlock. Someone emerged: Jeffer. They talked, heads bobbing. Debby moved to the front of the carm; Jeffer was about to go back inside—

Rather heard Jill calling. "Scientist! There's a burning tree coming toward us!" She paused to catch her breath. "We saw it, me and Rather, we—while we were swimming—"

Jeffer called back. "Debby told me. Did you see anything like winged men?"

". . . No."

"Okay. Help Debby with the moorings, there at the bow." He noticed Rather struggling in Jill's wake. "Get Rather to help you."

Debby and Jill were both fighting knots, and Jill was muttering "Treefodder, treefodder, treefodder," when Rather caught up. "I bent my finger," she said.

Debby said, "I hate to cut lines. See what you can do."

The carm's tethers hadn't been moved in years, and the knots were tight. Rather's stubby fingers worked them loose. *Dwarf. Clumsy but strong.* Presently the carm was held by nothing but its own inertia. Jill did not look pleased. Debby and Rather grinned at each other.

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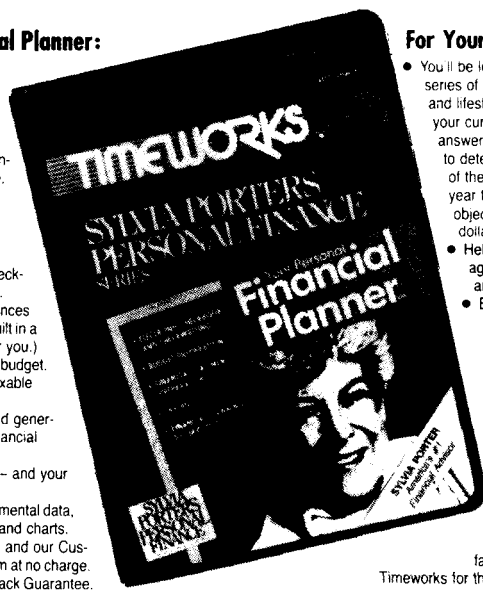

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From America's #1 Financial Adviser

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It was something, to do a thing an adult warrior could not!

Jeffer called from the airlock, twelve meters beyond the bark. "Come aboard!"

Debby jumped and Jill followed. Rather hesitated until he saw them bump against the airlock door. The jump looked dangerous. Tide was gentle, but one *could* fall into the sky. Rather had never been inside the carm, and he wasn't sure he wanted to be. The star-stuff box was like nothing else in or on the tree.

But he had to follow. He caught the edge of the outer door as it passed, pivoted on the strength of his arms and entered feet first. *Can't jump right, can't reach far. What if I'd missed?*

It was weird inside the carm. There were openings in the back wall, and hard round loops sticking out of the dorsal and side walls. Further toward the front were rows of cradles almost the size of an adult, ten in all, made of nothing like wood or cloth.

Rather made his way forward. The others were in the first row of cradles. "Take a seat and strap yourself in," Jeffer ordered. "Here, like this." He fastened two elastic tethers across Jill's torso. "Lawri showed me how to work these, years ago."

The cradle had a head rest that fitted nicely behind his ears. Jill's and Debby's dug into their shoulders. *It's true*, Rather thought suddenly. *The carm was built for dwarves!* He liked the thought.

"The winged men weren't very close," the Scientist said. "We've got time." His fingers drummed against the flat panel below the window.

There was tide pulling Rather forward, and a whisper-roar like a steady wind. The bark receded; the tree backed into the sky. Jill gripped the arm rests of her cradle. Her mouth was wide. Debby said, "Clave didn't say take off, Scientist. He said get ready."

"No time. They're headed for the trunk. Also the carm is *mine*, Debby. We settled that once."

"Tell it to Clave."

"Clave knows."

The invaders kicked themselves through the air, slowly, in the last stages of exhaustion. Five, it looked like, until Rather realized that the older woman carried a half-grown girl in her arms.

Jeffer nudged the carm toward them, in along the trunk.

Smoke Ring people came long, longer, or dwarf. These invaders were of the longer persuasion, like jungle giants, born and raised in free fall. They were quite human: an older man and woman and four girls. The wings were artificial, bound to their shins, made of cloth over splayed ribs. One girl trailed behind, struggling along with only one wing.

They were in sorry shape. Closer now, and Rather could see details. The man's hair was burnt, and the loose sheet that covered him was charred. The wingless girl was coughing; she didn't even have the strength to cling to the woman who carried her.

Their legs stopped pumping as, one by one, they saw the carm.

Debby said, "I don't see anything like bows or harpoons. Can we take them aboard?"

"I thought of that, but *look* at them. The carm scares them worse than being

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lost in the sky. Anyway, the man's almost there."

The burned man hadn't seen them. Kicking steadily, far ahead of the others, he reached the bark and clung. Without a pause he pounded a stake into the bark, moored a coil of line, and hurled the coil at the older woman. She freed a hand and caught it; pulled herself toward the tree; then snapped the line to send a sine wave rolling toward the trunk. The nearer girl caught the line in her toes as it bowed toward her.

Clave came around the bulge of the bark. He slowed when he saw the strangers. Gavving and Minya joined him. They moved toward the strangers.

There were four on the trunk now: a girl, the man, and the older woman with her coughing burden. Rather watched Clave take the burned man's line, hurl a sine wave across the one-winged girl's torso, and pull her in.

"Looks okay," the Scientist murmured.

Clave looked up and waved. Jeffer nodded and set the carm moving. "It's all right," he said. "They sure don't look dangerous. I wonder what happened to them? Where are they *from?*"

"I never saw strangers before," Jill said. "I don't know what to think."

"That burning tree is still coming at us," Rather said.

Jeffer nodded. The carm surged, turning.

Black smoke wreathed the middle section of the tree. Flame glowed sluggishly from within, illuminating blurred curves and oblongs. Debby said, "There's stuff in the fire. Made stuff, machinery. It'll burn up."

That was knowledge burning in the core of the fire. Jeffer hated what he had to say. "We can't save it. If we had Mark and the silver suit . . . no. That might burn even him."

"You're not taking us into the fire?"

"We can push anywhere. The tide will hold the tree straight." Jeffer had already taken them below the inward limit of the firecloud, where a black plume drifted east. The carm was passing north of the trunk. Jeffer tapped: the carm turned. "It's still dangerous. The tree could come apart while we're on it."

He moved in on the trunk. The bow grated against bark; Jeffer's crew surged forward against their elastic bands. "I think the carm was *built* for pushing," he said. He tapped a blue dash in the center of the panel, and the whisper of power became a whistling roar. Tide surged against his back.

This was what it was to be a Scientist. Knowledge, power, mastery of a universe. This was what Kendy the Checker had to offer. At what price? Who but a Scientist would have the strength to resist?

The sun passed zenith and started down its arc. Jeffer had changed the display; he watched sets of letters and numbers. The roar of the main motor strummed his bones.

Chapter Three: Refugees

From the Citizens Tree cassettes, 4 SM:

TIME

We've been trying to keep to Earth time, but that word "day" is about as useful as balls on a Checker. The closer you get to Voy, the shorter the days get, down to about two hours.

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Closer than that, the air's too thin and there's no water to speak of. At a ten-hour orbit, same thing, there's nothing to breathe. We've been keeping to ship-time. Twenty-four hours constitute a "sleep." A "day" is one orbit around Voy, wherever you happen to be. Gold's orbit is a "standard day."

The State takes its dates from the year of its founding. We've done the same, dating Smoke Ring years from four years ago. Our years are half a rotation of Voy and its companion sun . . . half because it's more convenient.

If *Discipline* ever does come back for us, Kendy will have to learn a whole new language.

—Michelle Michaels,
Communications

The huts of Citizens Tree were enclosures made by weaving living spine branches into a kind of wickerwork. The Scientists' hut was larger than most, and more cluttered, too.

The Scientists were the tribe's teachers and doctors. Any hut would have harpoons protruding from the walls and high ceiling; but here the wicker sprouted starstuff knives, pots of herbs and pastes, and tools for writing.

The hut was crowded. Lawri stepped carefully among five sleeping jungle giants.

She'd covered their wounds in undyed cloth. The strangers moaned and twisted in their sleep. The youngest girl, with her hair burnt down to the scalp on one side of her head, was holding herself half in the air.

The noise from outside wasn't helping. Lawri bent to get through the doorway. "Could you hold it down!" she whisper-snarled. "These citizens *don't* need . . . oh. Clave . . . Chairman, I'm trying to give them some quiet. Can you take the talk to the Commons?"

Clave and Anthon were intimidated into silence. Jeffer asked, "Can any of them answer questions?"

"They're asleep. They haven't said anything sensible."

Her husband merely nodded. Lawri went back in. Rustling sounds receded. For a moment she felt remorse. Jeffer would want to see the strangers as much as anyone.

When the burns healed they would be handsome, but in weird fashion. Only birds wore the gaudy colors of their scorched clothing. Their skin was dark; their lips and noses were broad; their hair was like black pillows.

The youngest girl stirred, thrashed, and opened her eyes. "Tide," she said wonderingly. The dark eyes focussed. "Who're you?"

"I'm Lawri the Scientist. You're in Citizens Tree. You're safe now."

The girl twisted to see the others. "Wend?"

"One of you died."

The girl moaned.

"Can you tell me who you are and how you came here?"

"I'm Carlot," the girl said. Two tears were growing. "We're Serjent House. Loggers. There was a fire . . . the whole tree caught fire. Wend got caught when the water tank let go." She shook her head; teardrop globules flew wide.

"All right, Carlot. Have some water, then go to sleep."

Carlot's drinking technique was surprising. She took the pottery vessel, set

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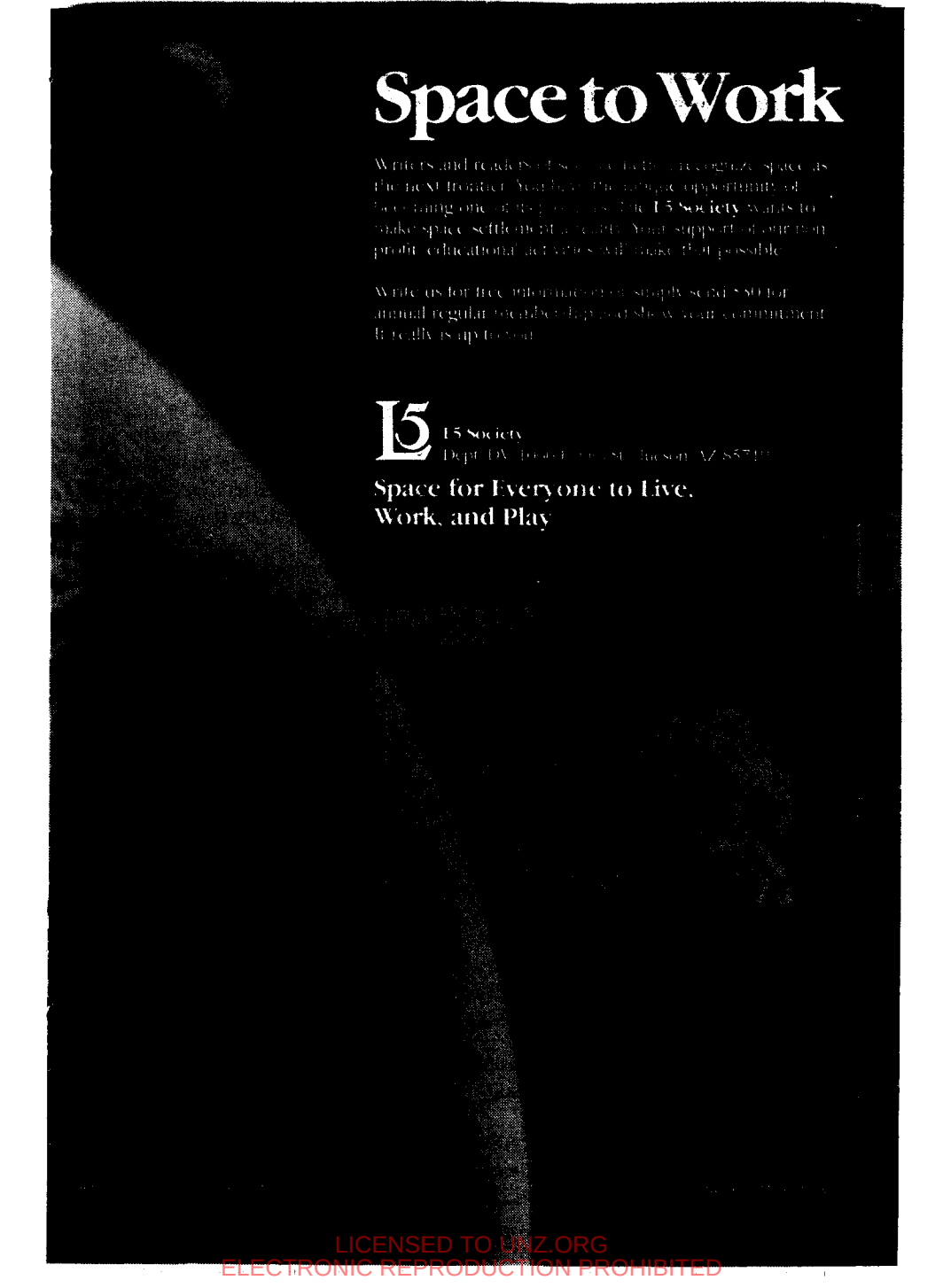

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two fingers to nearly block the opening, then jerked the pottery vessel toward her face. The jet of water struck her lower lip. She tried again and reached her mouth.

"Would you like something to eat? Foliage?"

"What's that?"

Lawri went out to strip some branchlets of their foliage. Carlot looked dubiously at the fluffy green stuff. "Oh, it's *greens*."

"You know it?"

"I've been in a tree tuft." She tasted it. "This is sweet. Older tree?" She continued eating.

Lawri said, "Later I'll get you some stew. You should sleep now."

Carlot patted the wicker floor. "How can I sleep with this pushing up against me? All my blood wants to settle on one side."

London Tree, Lawri's home, had been bigger, with a stronger tide. In Citizens Tree you could drop a stone from eye level and draw a slow breath and let it out before the stone struck. But this Carlot must be used to no tide at all.

She turned over, gingerly. Her eyes closed and she was asleep.

They moved through the green gloom of the corridor, back toward the commons. Anthon said, "I always wondered. Lawri doesn't take orders from you either, does she?"

Jeffer laughed. "Treefodder, no!"

Clave said, "I really wanted to ask them some questions before we tackle the firetree."

"We can't wait," Jeffer said. "Let's go see what we can scavenge. This is the most interesting thing that has happened to us in fourteen years."

"It's bound to bring changes."

"Like what?"

Clave grinned at Jeffer. "They've already changed your home life. You can't sleep in the Scientists' hut and Lawri won't leave."

"I've got the children too. I'm living in the bachelors' long-hut with my three kids and Rather. Look, I want to go *now*, before that burned tree drifts too far. Anthon?"

"Ready," said the jungle giant.

Clave nodded, reluctantly. "Just us three? Stet. We'll round up some kids to run the treadmill. And let's take those wings along. I want to try them."

The tree still burned. Fire had eaten six or seven klomters in from the midpoint along the lee side, progressing alongside the waterfall channel, where there was partial protection from the wind. The flames streamed east like the mane of a skyhorse. At the midpoint there were only red patches glowing in black char. In the center of the burn was a prominent uneven lump. Jeffer eased the carm toward that.

Clave said, "I don't understand why it hasn't come apart."

Anthon nodded uneasily. Jeffer said, "It's a short tree. With a tuft missing it's even shorter. Tide would pull harder on a grown tree, but that thing could still come apart while we're on it. I don't *ever* want to go through that again."

Anthon asked, "Why do trees come apart?"

"They do it when they're dying," Clave said.

Jeffer said, "When a tree drifts too

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far away from the Smoke Ring median, it starves. It saves itself by coming apart. The tide takes half of it out, half in. One half falls back to where the water and fertilizer are. The other half . . . dies, I guess."

"I still don't see any bugs," Clave said. "It's the bugs that eat a tree apart, isn't it? The tree isn't getting fed, so the bark lets the bugs get inside—"

"I don't know everything, Clave."

"Pity."

They were close enough now to make out black lumps at the center of the charred region. There: a shape like a huge seed pod split open from inside. There: a thin shell of char, a bell shape not unlike the fire-spitting nostrils at the carm's aft end. A ridge of white ash joined the bell to the split pod. Beyond: several fragile sheets of charred wood, the remains of an oblong hut with interior walls.

Clave reached for the wings he'd bound to cargo hooks. "Scientist, can you hold the carm here? We'll go see what there is to see. If the tree breaks in half, you'll still have us tethered."

Jeffer stifled a protest. He ached to explore that ruined structure, but . . . "I can handle it. Take lines, too."

The sun would be dead east in a few tens of breaths.

A stick protruded from the butt end of each fan-shaped wing. After some experimentation they settled for lining the stick along their shins and binding them with the straps. The wings tended to hang up on things even when folded. Clave and Anthon wriggled through the airlock and flapped into the sky.

Jeffer tapped the white button. "Prikazyvat Voice," he said.

The carm said, "Ready, Jeffer the Scientist."

Clave and Anthon fluttered erratically through the air. Suddenly Anthon moved purposefully toward the blister of charred machinery, moving easily, as if he had always been a bird. Clave moved after him, fighting a tendency to veer left.

They swept away the white ash that lay between the bell and the tank. The ash enclosed them in cloud. When the cloud dispersed, they had exposed a length of tube and a loose webbing of metal strands around it.

"Kendy for the State. Hello, Jeffer."

Jeffer didn't jump. "Hello, Kendy. What do you make of all this?"

"You'd know more about the injured plant than I. I've been studying the machinery." Within the bow window the metal strands and the enclosed pipe began blinking, an outline of red light. "These, the pipe and the chicken wire, are metal. The ruptured tank—" It blinked, "—appears to have been a large seed pod. The cone is half of a similar seed pod. The ash around the pipe appears to be wood-ash.

"We're looking at a steam rocket, Jeffer. Your invaders used a wood fire to heat the pipe. They ran water through the pipe and into the nozzle. Very inefficient, but in your peculiar environment they could move a tree like that. Slowly, of course."

"Why would they pick an injured tree?"

"Ask them. Did any survive?"

"One's dead. Five more are in bad shape. My wife won't let me near them. Wait a few days and see."

Clave and Anthon flew along the split

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in the great tank. They reached the cluster of black oblongs at the other end.

The Checker said, "Their wounds won't become infected. We didn't bring disease bacteria."

"What?"

"I was thinking out loud. I want to talk to your invaders. Take them on a tour, Jeffer, when they're ready. Show them the carm."

"Kendy, I'm not sure I want them to know about you."

"I will observe only."

Clave and Anthon were flapping back to the carm. They carried blackened cargo, and they no longer wore tethers. "Company coming," Jeffer said.

"Jeffer, you've concealed your contact with me from the rest of your tribe, haven't you?"

"I haven't mentioned it to them yet."

"I'll keep my silence while others are aboard. Play the game any way you like."

Clave and Anthon returned black with soot. They untied the now-clumsy wings, then wiggled in, pushing armfuls of blackened salvage ahead of them. Clave crowed, "I love it! It's really flying!"

"You never did like tide, did you, Clave? How's the leg?"

"It never gets any better." Clave flexed his right leg. The misshapen lump on his thighbone bulged beneath the skin and muscle. The compound fracture he'd suffered in Carther States had healed, but in the jungle there had been no tide to tell the bone to stop growing. "It feels like I strained it. If I have to fly any distance I'll use just one wing."

They set to mooring their loot along the walls. Two tremendous hooks, wood stiffened with metal. A meter's length of metal band with tiny teeth along one edge. A hardwood tube had kept its shape if not its strength; the remnants of charred plastic hose clung to one end.

"Weapons and tools," Clave said. "There was wire twisted together like a harebrain net, but it was burned through in too many places. Nothing else worth taking except the pipe. We've got to have that pipe. We moored the lines to it, Jeffer. Let's pull it loose."

"It must be important, given that you've moored the carm to a tree that's about to come apart. Why? Just because it's metal?"

"I've got a vague idea what this setup is for. We could duplicate everything except the pipe, in theory anyway. The pipe isn't just metal, it's starstuff, something out of the old science."

"Why do you say that?"

"We couldn't find a seam," Anthon said. "It gleams when you rub away the soot. Clave, I'm not sure I like any of this. Jeffer's right, that tree could come apart and throw us spinning across the sky, and for what? Wings, sure, those are wonderful, but the rest of this is just weird!"

Clave the Chairman said, "Pull that pipe out, Scientist."

Anthon fumed and was silent. Jeffer said, "Strap down. Let's hope the tethers hold."

Under attitude jets the carm shuddered and lurched. Then six meters of metal pipe two hundred ce'meters across pulled loose in a cloud of ash.

When Anthon and Clave went out to retrieve it, Jeffer went too. They watched, grinning, while he thrashed and spun;

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and suddenly he was flying, kicking stiff-legged across the sky like any swordbird.

They bound the pipe up against the hull and took the carm back to Citizens Tree. The burning tree continued to drift west and in.

Lawri kept the citizens away from her hut for five days, a full waking-sleeping cycle. That became impossible when she sent Rather for food. Rather came back with water bird stew, and Clave, Jeffer, Gavving, Minya, Debby, Jayan, Jinny, Mark, Jill, and a host of children. She kept them outside while the strangers ate. Then she and Jeffer pulled the hut's entrance apart. It could be rebuilt later.

The man named himself: Booce Serjent. He shaped his words strangly. He named the others: his wife Ryllin, and their daughters Mishael, Karilly, and Carlot.

"We've delayed the funeral until you're strong enough," Clave said. "Can you make yourself discuss funeral practices?"

Booce shrugged painfully. "We cremate. The ashes go into the earthlife tanks. What do you do here?"

"The dead go to feed the tree."

"All right. Chairman Clave, what has happened to *Logbearer*?"

"I don't understand."

"*Logbearer* is our ship. You saw a burning tree? The fire started around *Logbearer*, in the middle."

"We went there. We brought back a metal pipe and some other stuff."

"You saved the main feed pipe! How?"

"We used the carm. It's an old star-stuff relic, still working. We use it to move the tree."

Booce smiled and sighed and seemed about to drift off to sleep.

Lawri asked, "What are you? Carlot said *loggers*."

"Let him alone. I'm awake." The older woman sounded tired. "I'm Ryllin. Yes, we're loggers. We take lumber back to the Clump and sell it there."

Chairman Clave asked, "You mean there are men in there?"

Ryllin's laugh chopped off as if it had hurt her. "More than a thousand. With children, near two thousand."

"Thousands. Huh. And you move trees. Don't you have trees in the Clump?"

"No. The tide's wrong."

"How do you move a tree?"

"You cut off one tuft. Then the wind only blows on the other tuft. Booce generally takes us west, so of course we want the log to go east. So we cut the in tuft. The wind pushes just on the out tuft, so it pushes the tree west, and that slows it down. The tree drops closer to Voy and speeds up—"

The children and some adults were looking confused. *We taught them this!* Lawri thought angrily. *West takes you in.* Pushing a tree against the Smoke Ring's rotation—west—would drop it closer to Voy. Lower orbits were faster orbits. The tree would move east toward the Clump.

"—But of course we need the rocket too," Ryllin was saying. "A rocket is a tank of water, and a nozzle, and a metal pipe with a fire around it. You run water through the pipe. The steam sprays away from where you want to go. Without the pipe there's no *Log-*

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bearer. You understand reaction effects?"

The citizens looked at each other. Children understood the law of reaction before they could speak!

Ryllin said, "Well, when you get to the Clump you sever the other tuft and work the log to a mooring with the steam rocket. Then you have to sell it. We've done it all our lives. But the pipefire got away from us . . . Lawri? I'm tired."

Gavving said, "Sell?"

"Forget it, Ryllin. Everybody out," Lawri ordered. "Chairman, can you move them?"

The citizens drifted away in clumps of heated discussion.

Four sleeps after reaching Citizens Tree, all of the Serjents were on their feet. Various citizens volunteered to lead them about. They moved tentatively, slowed by healing burns and unaccustomed-to tide. They listened intently, and spoke in vowel-twisting accents and strange words . . . but for Karilly, who huddled close in the circle of her family, silent.

Booce and his family came back tired. Their new home was primitive, and roomy, and oddly beautiful. The citizens had managed well with so little.

Lawri the "Scientist" looked them over and judged them well enough to attend a funeral.

Chapter Four: The In Tuft

From the Citizens Tree cassettes, year 7 SM:

INTEGRAL TREES

. . . These integral trees grow to tremendous size. When such a plant reaches its full growth, it stabilizes by tidal effect. It forms a long, slender trunk tufted with green at both ends: tens of thousands of radial spokes circling Levoy's Star, each scores of kilometers long.

Like many plants of the Smoke Ring, the integral tree is a soil collector. The endpoints are subject to tidal gravity. And wind! The tufts are in a perpetual wind, blowing from the west at the inner tuft, and from the east at the outer tuft. The tide-oriented trunk bows to the winds, curving into a single, nearly horizontal branch at each end, giving it the appearance of an integration sign. The tufts sift fertilizer from the wind: soil, water, even animals and plants smashed by impact.

Free fall conditions prevail everywhere except in the integral trees. The medical dangers of life in free fall are well known. If *Discipline* has indeed abandoned us, if we are indeed marooned within this weird environment, we could do worse than to settle the tufts of the integral trees. . . .

—Claire Dalton, Sociology/Medicine

Foliage framed half a world of sky.

The treemouth faced west, at the junction between branch and trunk. Spine branches migrated west along the branch, carrying whatever their foliage had picked up from the wind, to be swallowed by the conical pit. Citizens came too, to feed the tree. The treemouth was their toilet, their garbage disposal, and their cemetery.

Lawri the Scientist had described all of this in advance. Booce tried to tell himself that it made sense; it was rea-

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sonable in context; it only took getting used to.

Wend had been placed at the lip of the pit. She'd had time to ride the spine branches halfway into the cone of the treemouth. Booce was glad that he could not see her better.

Burning was cleaner. Reducing the body to ashes burned away memories too. . . .

How was Karilly taking it?

Karilly was the quiet one. She obeyed orders, but rarely showed initiative. She almost never spoke to strangers. A good child, but Booce had never really understood her.

She hadn't been burned. All of them had watched Wend die; how could it be worse for Karilly? But she hadn't spoken a word since the fire.

Chairman Clave spoke, welcoming Wend into the tribe. Lawri spoke of a citizen's last duty, to feed the tree. Ryllin spoke her memories of her lost daughter. Karilly cried silently; the tears sheathed her eyes in crystal.

Older citizens ate first. Booce saw his daughters hanging back—they had learned that much already—while a Citizens Tree girl-child filled his bowl with waterbird stew from a large, crude ceramic pot. He lurched away across the woven-spine-branch floor of the commons, following his wife, trying to keep his bowl upright.

"You think of the tide as something to fight," his wife said softly. "Think of it as a convenience."

"Hah."

"Tide gives you a preferred direction. Something to push against. Look." With the bowl held in one hand, Ryllin leapt one-legged into the air and spun in a slow circle before her feet touched the floor again. She hadn't spilled a drop.

"Moving isn't unpleasant in a tide, it's just different. These, ah, *citizens* make us look clumsy, but we can adjust, love. We *will* adjust."

"Stet. I've climbed trees all my life. —Company."

They were surrounded by children. A pudgy half-grown girl said, "How do you move a tree without a carm?"

Booce said, "Let's sit down and I'll tell you."

A dozen children waited patiently while Booce and Ryllin nested themselves in foliage. Then they all settled at once.

Booce thought while he ate. He said, "You need a rocket. My rocket was *Logbearer*, and it was my father's rocket before me. To make a rocket you need a rocket."

One asked, "How did anyone build the first rocket?"

Booce smiled at the dwarf boy. "The first rocket was given by *Discipline*. It had a mind—the Library—and the Admiralty still has that, with more knowledge in it than you'll find in your little cassettes. Anyway, you've got to have a rocket so you can get to the pod groves."

A woman of Booce's own size settled within earshot. Booce pretended not to notice. "The biggest pod you can find in the pod grove becomes your water tank. You cut another pod in half and it's your rocket nozzle. You run the pipe into the stem end. You wrap sikenwire around the pipe to hold the firebark. You light the firebark. You pump water

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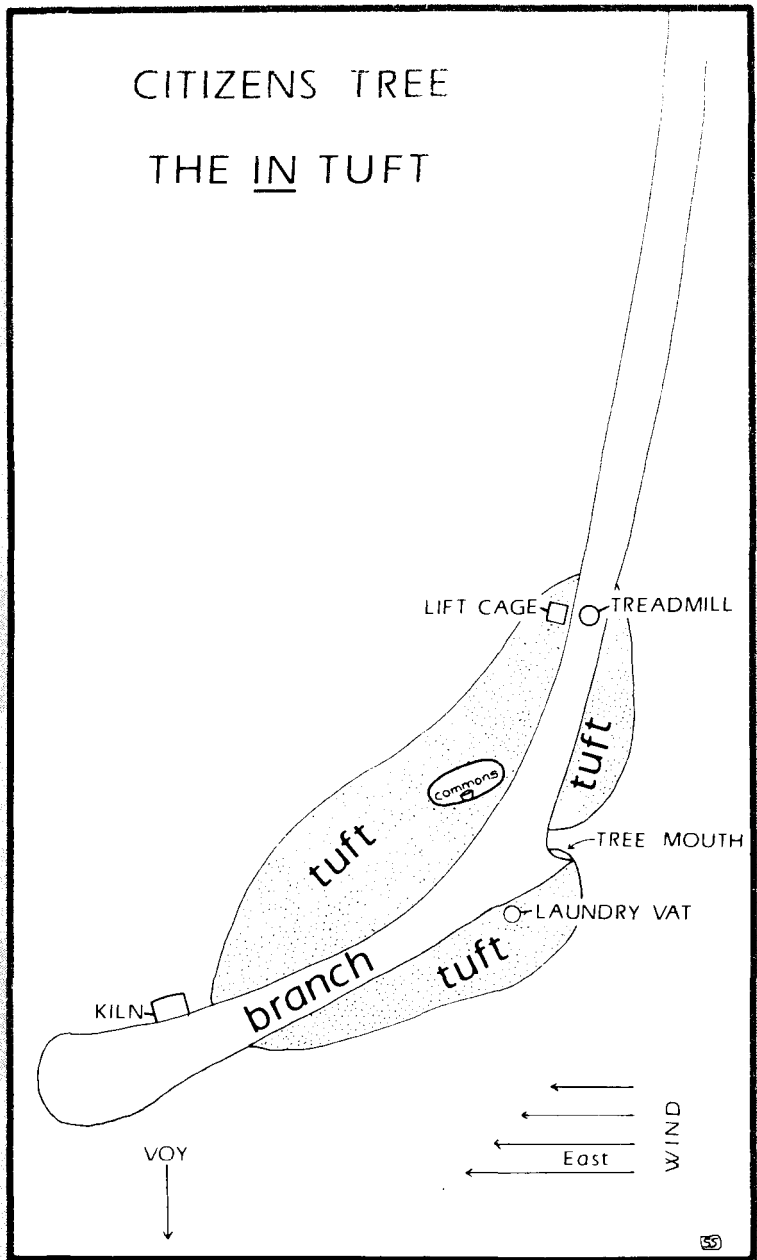

Diagram by Shelly Shapiro

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through the hot pipe and it turns to steam and goes racing out the nozzle, and that pushes you the other way."

The pudgy girl (though all the children looked a bit pudgy, well-fed and compressed by tide) asked, "Where does pipe come from?"

"I don't know. *Discipline*, maybe, if there ever was a *Discipline*." The children snickered. Booce didn't know why, so he ignored it. "There's a hundred and twenty meters of pipe in the Empire, so they tell me, and forty-eight of that makes up the pipes in eleven logging ships. *Woodsman* carries a spare pipe, but they're richer than we are.

"So. A rocket is one and a half pods, and a pipe and some sikenwire, and the hut complex at the other end of the tank. You need big hooks for towing, saws to carve up wood, and crossbows, because you've got to find your own food. A trip takes a year or two. Most of us travel in families.

"Now you find a sting jungle. The honey hornets live in the sting jungles, and there's nothing so big they can't kill it. You need to cover yourself all over to get at the nest. Honey is sticky red stuff, sweeter than foliage.

"Now you pick a tree. If it's more than forty klomters long the wood'll be too coarse and you'll be forever coming home. Thirty's about right. You moor your rocket at the midpoint, but you don't use it yet. You paint a line of honey down the trunk to one of the tufts. Then you gash the bark in a circle above the tuft, and paint honey along that. You know the bugs that eat a tree apart if it starts to die?"

Heads nodded. The Serjents had been told of the death of Dalton-Quinn tree. Children had to learn the tale early.

Booce said, "The bugs follow the honey down. They eat the honey above the tuft. Then they're stuck, because they've eaten all the honey. There's nothing left to eat but wood. After a few sleeps the tuft drops off."

There were sounds of dismay. "We don't use occupied trees, you know," Booce said gently. "The tree would die anyway when it gets near the Clump. Integral trees want a straightforward tidal pull, straight through Voy."

The pudgy girl asked a little coldly, "How many trees have you killed?" Booce saw that she was almost an adult. Her height had fooled him: the tide had stunted her growth.

"Ten."

The dwarf (an adult too, with beard beginning to sprout) asked, "Why do you cut off the tuft?"

"To move. You know the rule? West takes you in, in takes you east. I want the tree to move east, back to the Clump. So I cut the in tuft. Now I've got a west wind blowing on the out tuft, and nothing at the in stump to catch the wind. The tree accelerates west. It drops toward Voy. Things move faster when their orbits are closer to Voy, so the tree moves east. After a while I'm in from the Clump and still moving. That's when I need the rocket. I have to cut off the other tuft, then fire the rocket to move the tree into the Clump."

The dwarf boy asked, "What then?"

"Then I sell the log for what I can get, and hope nobody else brought a log in at the same time. If there are two of us competing, we might not get enough to pay us for the work."

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Most of the children looked puzzled. The dwarf asked, "What went wrong this time?"

Booce's throat closed up. *His* decision! With some relief he heard Ryllin say, "We were in a hurry. We thought we could get more water for the rocket. So we set the rocket going before the tuft dropped off. That started a fire. Wend was trying to get out of the huts when the water tank—well, it got too hot and—"

Booce jumped in, hastily. "The water tank split open. Wend got caught. Carlot and I were burned pulling her out of the steam. We were steering the log for that pond out there, and your tree moved in front of it, so it was the closest. So we made for it. And you found six of us clinging to the trunk like tocs in hair, and—and Wend was dead, and the rest of us were ready to die, I think."

The adults had all been served. The children drifted toward the cookpot. Booce ate. He'd let his stew get cold.

Likely he would never see the Clump again. It was just as well. He and his family would be paupers there. He had never owned anything but *Logbearer* itself, and even that was gone. But was it really beyond belief that these people could build another *Logbearer*?

When all the adults were eating, the children drifted into line at the cookpot. Rather was just ahead of three tall and dark young women, and just behind his brother Harry.

"Take Jill's place," Rather told Harry.

"Why should I?"

"Beats me. Will you do it?"

"All right."

The favor would be repaid. Rather would take Harry's place at the cookpot or in the treadmill, or show him a wrestling trick; something. These things didn't need discussion. Harry stepped out of line and talked to Jill where she was serving stew. Jill served herself and Harry took her place.

The blond girl joined Rather. "What's that for?" she asked; but she seemed pleased.

"I've been listening to the old ones. Now I want to talk to the girls. Come along?" If they wouldn't talk to a dwarf boy, maybe they'd talk to a girl.

They followed the Serjent girls as they made their exaggeratedly careful way across the commons' wicker floor. The refugees settled slowly into the foliage, keeping their eyes fixed on their bowls. Stew still slopped over the edge of Carlot's bowl. "The hole's too big," she said.

"You just need practice. —I'm Jill, he's Rather."

"How do you eat when you're at the midpoint?"

Jill and Rather settled across from them. Rather stripped four branchlets for chopsticks. Jill said, "I'd take a smoked turkey along. What do you use? Bowls with smaller holes?"

"Yes, and we carry these." Carlot produced a pair of bone sticks, ornately carved. "You're lucky. You've always got . . . spine branches?"

"These are branchlets. The spine branches are the big ones."

The third girl, Karilly, had not spoken. She was concentrating fully on her bowl.

Mishael said, "You seem to be happy."

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Rather found the comment disconcerting. "What do you mean?"

"You, all of you. You've got your tree and it's all you need. Lumber from the bare end of the branch. The clothes you wear, the cloth comes from branchlet fibers, doesn't it?"

"It's foliage with the sugar washed out."

"And the dye is from berries. Water comes running down the trunk into that basin, and you eat foliage and catch meat from the sky. And there's the carm. Without the carm you'd have to build a rocket to move the tree."

"Right." Rather thought, *We don't know how to do that. The carm is all that keeps us from being savages. Is that how they see us?* "We had to leave the tree to get our lines. And the adults keep talking about earthlife crops. They couldn't bring seeds and eggs with them."

"You could buy them in the market if you were rich enough."

Jill said, "We don't know those words. Rich? Buy?"

Carlot said, "Rich means you can have whatever you want."

"Like being Chairman?"

"No—"

Mishael took over. "Look, suppose you want earthlife seeds or pigeons or turkeys. Stet, you go to the Market and you find what you want. Then you've got to buy it. You need something to give the owner. Metal, maybe."

"We don't have much metal," Rather said. "What are the people like? Like you?"

"Sometimes," Carlot said. "What do you mean? Tall? Dark? We get dark and light, short and . . . well, mostly we're about as tall as me, and the men are taller."

"No dwarves?"

"Oh, of course there are dwarves. In the Navy."

"What do you think of dwarves?" He hadn't meant to ask so directly; he hadn't realized how important the question was to him.

Carlot asked, "What do you think of my legs?"

Rather blushed. "They're fine." They were hidden anyway; Carlot was wearing the scarlet tunic and pantaloons of Citizens Tree.

"One's longer than the other. My teacher's got one leg longer than mine and one leg like yours, and it never bothers *him*. And the Admiral's got an arm like a turkey wishbone. I've seen him. We're all kinds, Rather."

It was Mark's habit to eat near the cauldron, where others might find him. Rarely did he get company. This day he was mildly surprised when Clave and Minya settled themselves across from him. They plucked branchlets and ate. Presently Clave asked, "What do you think of the Serjents?"

"They're doing all right."

"That wasn't what I meant," Clave said, while Minya was saying, "What will they do to Citizens Tree?"

"Oh." Mark thought it over. "Half of you came from the in tuft of a broken tree. You were from the out tuft, Minya. Three from Carther States. Lawri and me from London Tree. London Tree used to raid Carther States for copsiks. Fourteen years we've been living here, and nobody's killed anyone yet. We can live with the Serjents too."

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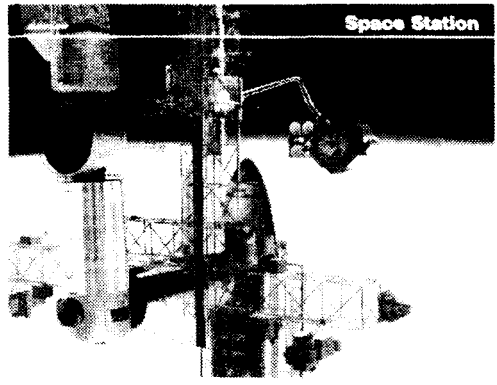

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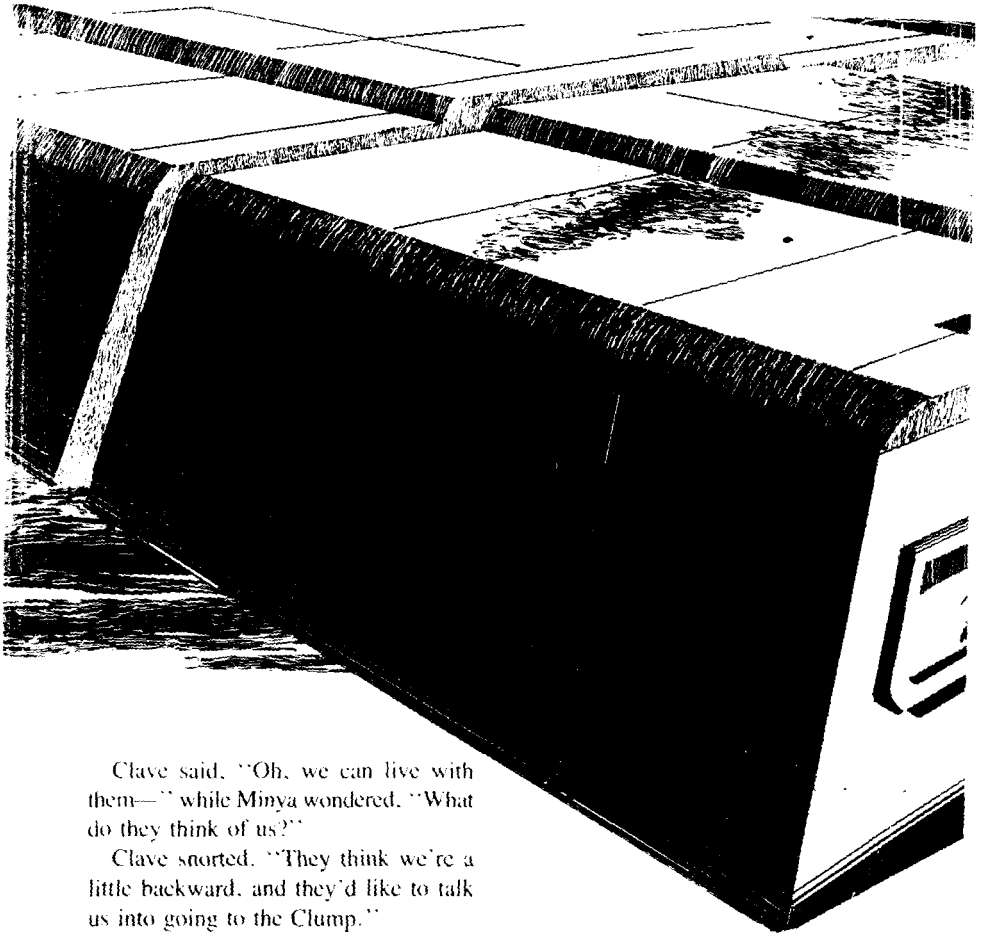

Clave said, "Oh, we can live with them—" while Minya wondered, "What do they think of us?"

Clave snorted. "They think we're a little backward, and they'd like to talk us into going to the Clump."

Where was this leading? Mark asked, "Are you thinking they want the cam?"

"No, not that. Not impossible, either. . . . Have you talked to Gavving or Debby lately?"

"They don't like my company. Neither do you, Minya."

Minya ignored that. "They're trying to figure out how to build a steam rocket, starting with just the metal tube they brought back!"

"Uh *huh*." Mark saw the point now. "They can build us a machine that moves trees around. They can tell us why we should all go to the Clump. So you're a little nervous, Chairman? We could lose half the tribe. Lawri keeps saying there aren't enough of us *now*."

"And what do you want, Mark?"

Mark would have wished for a wife or three, but he saw no point in telling Clave or Minya that. "I want nothing from the Clump. We're here. Twelve adults, twenty children, happy as dumbos in Citizens Tree. We shouldn't be announcing that all over the sky. Even if the Clump doesn't keep copsiks, maybe somebody out there does. Things

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aren't perfect here, but they're good. I wouldn't want to wind up as somebody's copsik."

Clave nodded. "That's what I'm afraid of."

Minya said, "We worked so hard to make this our home. Gavving knows how close we came to dying. How can he risk what we've got?"

"We seem to be agreed," Clave said briskly. "Well? What do we do about it?"

Lawri and Jeffer were missing dinner. Lawri had led her husband east along the branch, beyond the region of the huts. In a dark womb of foliage and branchlets, they were making babies.

Resting, relaxed for the first time in many days, Lawri plucked foliage and put it in Jeffer's mouth. He talked around it, indistinctly. "Does this remind you of being young?"

She lost her smile. "No."

He leered. "Little London Tree boys and girls never snuck off into the foliage—?"

She shook her head violently. "It isn't like that for a girl in London Tree. When boys get old enough, they don't need us. They go to the in tuft. Copsik women belong to any male citizen. Jeffer, you know that much!"

"I should. That's how Mark got Minya pregnant, before we got loose."

She changed position to lie along his length. "If he did. Any man can father a dwarf."

"Even Rather doesn't believe that."

"Bother him?"

"Yeah . . . But women had children in London Tree, didn't they? And married?"

"Yes, if we were willing to act like copsiks ourselves. How else could we compete? I would've been some man's copsik if I wanted to make babies. So I never made babies."

Jeffer looked into her eyes as if seeing her for the first time. "Are you glad I came?"

She nodded. Perhaps he couldn't see her blushing in the near-darkness.

"Why didn't you ever tell me?"

That was a stupid question. Knowing how she needed him, he'd use his advantage to win arguments! "This wasn't what we came to talk about."

"Did we come to talk?"

"What did you find on the burned tree?"

"We didn't keep any secrets. —That's right, you weren't there when Booce was telling us what we had. Well, we got a pot full of charred stuff— honey, he said— and a metal thing for cutting wood, and hooks . . . miscellaneous stuff. And the metal pipe. Everything else that burned— I've forgotten what he called it all, but it can all be replaced, except the—what did Booce call it? The sikenwire."

"I want to go to the Clump," Lawri said.

"Me too. Clave would never let both Scientists go." Jeffer kissed her cheek. "Let's wait till the last minute and then fight about it."

"What about the sikenwire?"

"We'll think of something. Do you think Clave will let us take the carm?"

". . . No."

She felt him shrug. "Okay. We go as loggers?" She nodded (their foreheads brushed) and he said, "I'd guess Clump citizens will all look like jungle

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giants. We should have a few. Anthon and Debby'll come. A couple of the Serjents for guides. Defenses . . . we wouldn't want to risk the carm in the Clump, but we could take the silver suit."

"Wrong. A lot of citizens don't want anything changed. Clave thinks we're too close to the Clump already. He wants to take us farther west. Mark agrees with him."

"Yeah, I've talked to Mark. Tree-fodder. Without him we can't use the silver suit . . . Lawri? Clave wants to move us west?"

"What are you thinking?"

"We don't know enough yet. Forget it. Look what you missed when you were a little girl . . . "

Whatever the disagreements now roiling through Citizens Tree, there was at least this bone of consensus: they all wanted to fly.

The Serjent girls were willing. From branchwood sticks and from cloth that was made on the looms below the branch, they made wings. Karilly worked quietly and skillfully and without words. Mishael and Carlot explained as they went, and corrected the mistakes of the children who emulated them. The work went fast. Citizens would wear their old tunics and pants for half a year longer, for cloth was not made quickly; but twenty-four wings were ready within twelve days.

Jeffer took Mishael, Minya, Gavving, and eight of the older children to the midpoint via the lift. Other children ran with zeal in the treadmill, knowing that theirs would be the next flight.

Jeffer had chosen with some care. These were the children who had not shied back from crossing to the pond on the day of the fire-tree. Yet there had been lines to cling to then. Today there was only bark, and some of them clung to that.

Rather flew, and was instantly in love with wings. Jill looked like she was facing death, but when wings were bound to her ankles and Rather was already in the sky, she flew. Mishael served as instructor. Jeffer learned how to kick, how to turn. When the sky was filled with winged adults and children, the rest gulped hard and loosed their hold on the bark and flew.

They were in the sky for one full circle of the sun. The adults had their hands full herding them back to the lift. Arth made a game of it, fleeing across the sky until Jeffer and Gavving closed in on him and pulled his wings off. The sun was rising up the east before they had the children rounded up.

Then Jeffer sent the others down without him. He told Minya, "I want to do some maintenance. Start the lift again after you're down."

"Kendy for the State. Hello, Scientist."

"Hello, Kendy."

"How are your refugees?"

"Four of the Serjents recovered. One of the girls, Karilly, looks okay but she doesn't talk."

"Shock. She may recover. When may I see them?"

"Kendy, I wanted to give Mishael a tour of the carm. The Chairman vetoed that. He's afraid they'll try to steal the carm."

"Nonsense. What do the rest of your

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tribe think?"

"We're split down the middle. Half of us want to go see what's in the Clump. They've got a place . . . the market? . . . where we could get anything we want. The Serjents told us about it."

"And?"

"The Chairman is scared spitless of the Clump. He thinks we're too close now. Some of the others feel the same way. Jayan and Jinny, of course, but Mark and Minya too. Even the Serjents don't all want to leave. Mark's asked Ryllin for permission to marry Karilly, and she gave it."

"Good. How do you feel about this, Jeffer?"

"I want to see the Clump. Booce told me they've got something they call the Library, but it sounds like a carm autopilot. I want to scan their cassettes. Kendy, I'm doing what I can. I just took some of them flying. They like that. Maybe they'll start wondering what else they're missing."

"I remember Clave. He leads his citizens where they want to go. Call a council. Force your citizens to make a decision."

"What good does that do us?"

"If you lose the vote, you'll know where you stand. Then make Clave set a date for moving the tree. Decide what you need and whom you need. Is there any chance you can talk Mark around?"

"None."

"The Serjents told you how to go about setting up a logging enterprise. Tell me."

The children slept on, exhausted by their flying. Gavving was making an early breakfast on a slice of smoked dumbo meat. He said, "The Admiralty has earthlife plants."

"We've lived without them for fourteen years," Minya said sleepily.

"We lived without lifts and the carm for longer than that. It was because we didn't *know*."

"The Admiralty has never touched us. We wouldn't know it exists, except that Booce tells us so. But you want to know more. Aren't these matters more properly discussed in Council?"

Gavving looked closely at his wife. "You looked like this fourteen years ago, when you were trying to kill me. The whole tuft is like that. There hasn't been fighting like this since the War of London Tree!"

"I haven't forgotten London Tree. We made a home here. Any change is for the worse."

"Dear, are you sorry they came?"

"No!" Minya said with some force. She was fully awake now. "There aren't enough of us. We all feel that."

"Lawri the Scientist talks about the gene pool being too small—"

"We don't need that gibberish. We can *feel* we're too few. Now we have three more women, even if Rhyllin is too old to host a guest, and they're *different* from us—"

"They are indeed!"

"Well, that's good!"

"Suppose they want to go home?"

"They can't," Minya said flatly.

A child stirred: Quen. Gavving lowered his voice. "Suppose we built them another rocket. Suppose some of us wanted to go with them."

Minya stopped to sort words through her head. Gavving waited patiently.

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Presently she said, "They'd have to be crazy. We'd have to be crazy to let them go. Gav, have you forgotten London Tree?"

"No. I haven't forgotten Quinn Tuft, either, or Carther States. *They* didn't make citizens into copsiks, and neither did your people."

". . . No. But we attacked you the instant we saw you."

"True."

"Do you remember being lost in the sky, clinging to a sheet of bark and dying of thirst? We faced dangers we can't even describe to our children, because they're too strange! We fought hard for Citizens Tree! And now *both* Scientists want to cross a thousand klomters to the Clump shouting, 'Here we are!' Why do you want to risk what we've got?"

"They've got things to trade. They've got wings—"

"We've got wings."

"We picked jet pods, when we could find them. All this time. And it's so *simple!* Minya, what would you have given for a pair of wings, when we were stranded in the sky? Everything in the Smoke Ring can fly except men, and all it takes is spine branches and cloth! They've got a rocket that moves a tree, and it isn't stolen starstuff, it's made mostly from things they find in the Smoke Ring. What have they got in the Clump? What haven't we seen yet?"

She put bitterness in her laughter. "A thousand people and a drastic need for copsiks, maybe."

Gavving sighed. "Stet, you don't want anything changed. What should we do? They're *here*."

"Make them welcome," said Minya. "Teach them how to live in a tree. Get the girls married. Make them part of us. Gavving, Mark intends to marry Karilly."

"Karilly's sick in the mind. She isn't getting over it."

"Sure, and Mark's a dwarf. He's needed a wife, and none of us would touch him. I never did feel *sorry* for the copsik runner, but . . . but he's willing to take care of her. And I think you ought to marry one of the other girls."

Bang! Gavving stared. *This* was a woman afraid of changes? "I am married."

"Clave has two wives. Anthon did, until Ilsa died. I'm getting too old to make babies, dear."

"You don't mean—"

"No!" She hugged him. "But it won't give me a guest to carry."

"You're serious? Okay, who?"

She hesitated. Then, bravely (he thought), "I would have thought Mishael. She's the oldest. Gavving, she showed me how to fly. I like her."

"Have you mentioned any of—"

"No, you fool! A woman doesn't ask a woman to be her wife!" And when he laughed she smiled, weakly. Gavving saw how difficult this was for her. Minya must have thought long and hard about this.

"There's room to extend the hut," she said. "We'd have another pair of hands, adult hands. The children are growing up, they're not as much fun any more—"

And if some of us marry Serjent women, we'll have their loyalty when the Admiralty comes to us! Logbearer *can't be the only ship in the sky.* Gavving wondered if his brain was working

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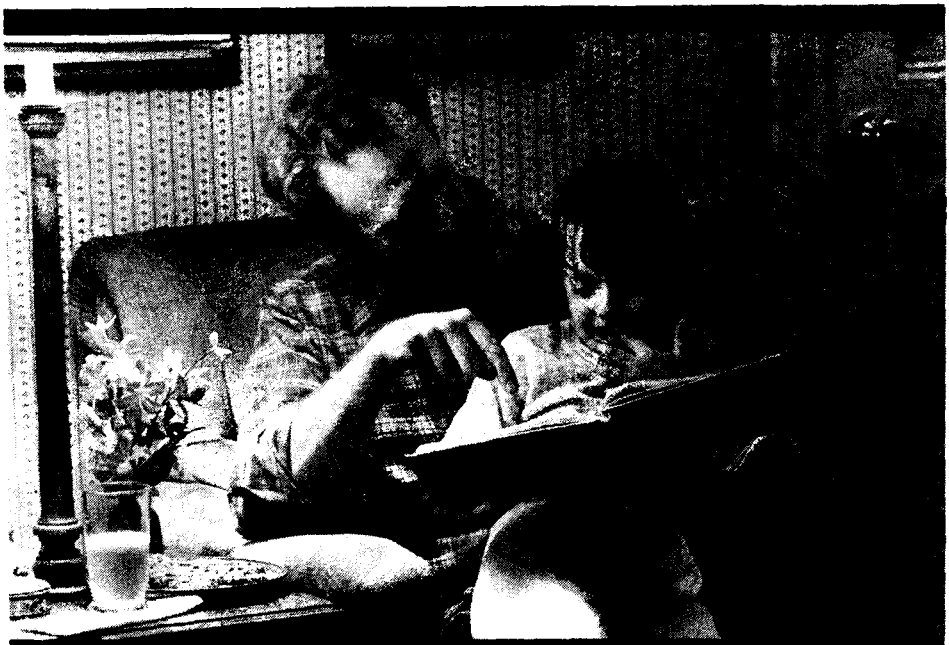

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in the service of his seeds. Minya had not referred to Mishael's alien beauty.

And if we do visit the Clump, his brain ran on, *we'll need guides. Booce or Ryllin would have to go. With their daughters among us, we'd have their loyalty—*

Chapter Five: The Silver Suit

From the Admiralty cassettes, year 3 SM:

> We were chosen for this. No citizen leaves Earth orbit until the State has learned his tolerance for free fall. One in ten thousand has the genetic quirks to survive months or years of free fall without softening of the bones, without failure of the digestive system, without the terror of falling.
>
> We served the State by flying to the stars. When the drive was off we played at flying, while cramped in a seeder ramship with barely room to flap our arms. Here is real flight. Of *course* the Smoke Ring seems an incredible dream come true—to *us*.
>
> —Sharon Levoy, Astrogation

"Kendy for the State. Hello, Jeffer. It's been more than thirty days."

"I was busy. We got our council. It's over."

"How did it go?"

"We lost."

"Who sided against you?"

"Clave. Jayan and Jinny. Minya. Mark."

"Five out of ten. If you count the Serjents, twelve."

"Thirteen. Mishael's old enough, and married too, but she acts like a junior wife. She won't make Minya *or* Gavving angry. Gavving doesn't want to fight with Minya. The Serjents don't think like citizens yet. Anthon won't get into the arguments. I'm not really sure where he stands. The rest of us want to see what's out there, but we don't all want it enough. Debby loves arguing, but she's not very good at it. We didn't give Clave any trouble at all."

"You're disappointed. Don't be. Did you think that flying would bring them around? People tend to side with authority, and authority tends to protect its own power. Clave is the key. Clave has everything he wants in Citizens Tree."

"Kendy, do you see us as savages?"

"Yes. Don't take that too seriously, Scientist. I would probably see the Admiralty as savages too. I want to educate you all."

"Then educate me, Kendy. I can't just take Booce and Ryllin and go off into the sky. We—"

"You must go, Jeffer. The wealth of the L-4 point is almost irrelevant. It takes many people to hold a civilization together. There are too few of you here to be more than savages!"

Jeffer didn't react to the insult, barring an increase in infrared radiation from his cheeks, neck, and ears. "We'd need things Citizens Tree can't spare. Lawri's on my side, but we can't both go. The tree needs a Scientist. We'd have to take the carm, too. We—"

"Take it."

"You're not serious. Dalton-Quinn Tree died because we couldn't move it. I won't see it happen to Citizens Tree."

"Bring the carm back when you're through with it."

Jeffer paused to think. (Kendy never did that. It was another reason to distrust

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Kendy: he seemed to *leap* at his answers, without forethought.) "We might lose the carm."

"You can build a steam rocket. Jeffer, I'm drifting out of range."

"We've got *one* pipe, and we need that to be loggers. Without the pipe Citizens Tree couldn't build a steam rocket. I wouldn't have *believed* that so much could change in twenty sleeps. Kendy?" The signal dissolved in noise.

Kendy returned to his records.

For twenty State years CARM #6 had been taking pictures, not just through the CARM cameras but through the fisheye lens on the pressure suit, too.

Here: the squirrel cage that ran a muscle-powered lift, and the lines leading up. Far too much footage of that.

Here: fire burned in a great bowl of soft clay. The silver suit moved around the edges of the fire, poking it, or adjusting sheets of bark that had been set as vanes to channel the wind into the burning wood. The look of the clay began to change.

Here: less fire than smoke. What looked like enough spaghetti to feed the entire State government had been spread leeward of smoldering wood. The pressure suit moved around and within the mass, turning it and loosening the strands—vines—with the handle of a harpoon so that the smoke would cure them. These were the lines that now served Citizens Tree.

Ingenious. A poor way to treat State property; but they were making use of local resources, too.

The platform around the cookpot was of boards tied with line. It had always been flimsy, and that didn't matter much in Citizens Tree's low tide; but over the years the lines had loosened. Jayan and Jinny complained about the way the platform lurched while they tried to make dinner. So Rather and Carlot had been sent to repair the platform.

Rather enjoyed the work. It called for muscle rather than dexterity. He lifted one end of a new branchwood plank into place. He called "Hold this," and waited until Carlot was set. Then he bounded down to the other end and hoisted that.

Carlot giggled.

Rather began to tie the planks. One loop of line to hold it, then he could work on a more elaborate mooring. He asked, "What's funny?"

"Never mind," Carlot said. "Are you going to tie this for me?"

"I thought I'd just leave you there. You make a good mooring, and decorative, too."

"Oh." She held the planks in place with one arm while she reached out. Her right leg was twenty ce'meters longer than the left, and she usually reached with that. Her long toes grasped a coil of line and pulled it to her hands. She tied a temporary binding.

In the twenty-two sleeps since their arrival, all of the Serjent family had become dextrous in Citizens Tree tide.

Rather wrapped a dozen loops of line around the plank-ends, then began tightening them. Heave on a loop, pull the slack around; again. From the opening beyond the treemouth the wind blew steadily, drying sweat as fast as it formed.

Carlot called from her corner. "That's as tight as I can get it."

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Rather was finished at his end. He jogged down to Carlot's end (ripe copter plants buzzed up around his feet) and began pulling in slack. She'd left a good deal, of course. Carlot was agile, but not strong. He asked, "What got you giggling?"

"Just the way you scurry."

Rather's hands paused for less than a second, then continued.

"You did ask," she said defensively. "You have to go running back and forth because you can't reach as far as—"

"I know that."

"Did you make this cauldron yourselves? I wouldn't have thought you could do that here. It's big enough to boil two people at once."

"Hey, Carlot, you don't really *eat* people in the Empire, do you?"

She laughed at him. "No! There's a happyfeet tribe that's supposed to do that. But how did you make it?"

"The grownups found a glob of gray mud west of the tree. Maybe it was the middle of a pond that came apart. They brought some back. We took all the rocks in Citizens Tree and piled them in a bowl-shape, out on the branch where we couldn't do any damage. I was just a kid, but they let me help with the rocks. We plastered the mud over the rocks. We got firebark from another tree and piled it in the bowl-shape and fired it. It took a dozen days to cool off, and then it was like that. We did it twice—"

"You're cute," she said solemnly.

Carlot was a year older than Rather. An exotic beauty was growing in her. Half her hair had been burned off, and she had cut the rest to match. Now it was like a skullcap of black wire. She was two and a half meters tall, with long fingers and long, agile toes, and arms and legs that could reach out forever.

Carlot affected Rather in ways he wasn't quite ready to accept. He said, "Put it in the treemouth. When do I get to be overwhelmingly handsome?"

"Cute is good. If I weren't your aunt—"

"Treefodder."

"Are you not my nephew?"

Rather studied his work. "I think we're done. —It's an Empire thing, is it? You don't make babies even with relatives of relatives? Fine, but you've got a thousand people in the Empire! At least that's what your parents say. We had ten adults and twenty children when you came. I won't get much choice about who I marry."

"Who, then?"

He shrugged. "Jill's a half year older than me. All the other girls are younger. I'd have to wait." The subject made him uncomfortable. He looked up past the treadmill and along the trunk, to where a handful of citizens were trying their wings. "I wish I was up there. You've been flying all your life, haven't you?"

"I *should* be there, showing you people how to fly. This damn fluff," Carlot said. Long sleeves were sewn loosely to her tuftberry-scarlet tunic. She pulled one away. The green fur along her arm had turned brown; the patch had shrunk. "How's yours?" She touched his cheek. The patch felt half-numb and raspy; it ran from his face down his neck and across part of his chest.

"It's drying up. Ten days, it'll be cleared up."

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"Too treefeeding slow."

"We just have to stay in the shade for awhile. Fluff needs sunlight."

"Yeah."

From eastward, his first mother's voice called above the wind-roar. "Rather!"

Rather bounded toward Minya across the floor of braided, live spine branches. Carlot gave him a good head start, then bounded after him. Her asymmetric legs gave her an odd run, a pleasure to watch: boundBOUND, boundBOUND, low-flying flight. Soon she'd be faster than Jill. She reached Minya a good six meters ahead of Rather, turned and flashed a grin at him. She lost it immediately.

"—Crawled too far toward the tree-mouth, and now he can't— Rather! It's the children. Harry and Quen and Gorey went crawling around in the old west rooms. Gorey went too far, and Harry and Quen can't reach him, and he can't get out."

"You can't get to him?"

"I didn't try. Rather, we don't know how long it was before Harry came to get us."

"Oh." Harry would have tried to rescue Gorey himself, then spent more time working up the nerve to tell his mother. And Gorey was only five! "I'll need some kind of knife," he said.

"What?"

"I'm no narrower than you are, First Mother. I'm just shorter. I may have to cut through some spine branches."

The wind didn't reach Mark's long hair and beard. They held the sweat like two sponges. The slab of hard branchwood strapped to his back massed as much as he did. He scrambled up the slope of the treadmill, panting, trying to stay higher than Karilly and seven children. With a weight on his back Mark was the equal of any two adults.

The treadmill was six meters across and four wide, a fragile wheel of branchwood sticks. Water running down the trunk helped to spin it, but runners were still needed.

It was getting easier; the treadmill was spinning faster. The cages must be almost passing each other. "Out!" Mark panted. "Runners, out!" Seven laughing children jumped from both sides of the treadmill, until only Mark and Karilly were left.

Above was a sudden glare as the sun passed into view.

Karilly's dark skin shone with sweat; she breathed deeply as she bounded uphill alongside him. He knew she could understand him. "Karilly. When the up cage is at the top it . . . doesn't weigh anything. It takes all of us . . . to lift the down cage. Right now . . . the cages are next to each other. I can run by myself. In a little while . . . the down cage will be falling. I'll have to get out. Use the brake. Slow it down." She watched him as if she were listening. "So you jump out now."

Then he saw that she was afraid.

"Okay." He let the cage carry him around. Inverted, he scrambled down the other side. "I'm slowing it. Can you get out now?"

Karilly scrambled out.

Twenty klomters over his head, Lawri and her student flyers must be wondering what had gone wrong. Mark started the cage spinning again, letting his body do its accustomed work while

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his mind drifted.

Long ago and far away, there had been civilization.

London Tree had had stationary bicyles to run the elevators to the tree midpoint, and copsiks to run the bicycles. Citizens Tree was primitive. They had London Tree's carm, of course: a thing of science dating from the day men came from the stars. Otherwise they must build everything.

Mark had shown the refugees how to build a lift. Mark had wanted to make bicycles, but the Scientists had built the treadmill instead. They kept the silver suit next to the treadmill with its helmet open. Citizens at the carm could call for the lift through the radio in the suit.

Below him he could see the hollow space of the commons, and two children bounding east. The tall, dark girl was far ahead of the smaller boy, who moved in slower, shorter steps, as if tide were heavier for him.

His son. His size proved it. Mark would not have wished that on him; yet Rather would be the next Silver Man. Mark wondered if the citizens would appreciate their fortune. In the short lifetime of Citizens Tree there had been no need for an invulnerable fighter, and the silver suit had become a mere communications device.

Had it not been for one stupid, stubborn act, Mark would still be a citizen of London Tree. But he would never have seen the stars, and he would never have seen his son.

The treadmill was spinning by itself. Mark jumped out. He set the branchwood slab down. He looked up along the trunk, but he couldn't see the down cage yet. "We'll let it run for a bit."

If Karilly could talk, would she still smile at him like this? He took her hand. "Lawri wanted you with them. You were afraid to go up, weren't you?" He had known a London Tree citizen who was afraid of falling. It was instinct gone wrong. If such a woman were born in a place like Carther States, would she be afraid all the time? Until the added terror of a fire pushed her over the edge.

"Lawri wanted me up there too. I wonder what it's like. Flying."

But the silver suit caught his eye. *No.*

His business in London Tree had been war. Were there copsik runners in the Clump? Karilly would know. "I wish you could talk. The Scientists can't marry us till you can say the words. The key word is *yes*. Will you try? *yes*."

"Mark!"

He jumped. "Debby?"

She called from below. "Yeah. Shall we relieve you?"

Mark swallowed his irritation. "The empty's coming down. You want to brake when the sun's at about eleven."

"We'll do it." Debbie and Jeffer climbed up to join them. "Hello, Karilly."

Jeffer said, "You didn't go flying? You should try it."

"Not me. I'm the Silver Man. I fly with the silver suit. Come on, Karilly." Maybe somebody would need muscle at the cookpot platform.

The tunnels ran through the tuft like wormholes in an apple. Unused tunnels tended to close up; but passersby ate from the foliage as they passed, so the tunnels in normal use stayed open. One such tunnel ran past Rather's home.

At its west end Rather could have

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circled the hut with his legs. This was the oldest section. As the spine branches migrated west along the branch, eventually to be swallowed by the treemouth, enclosures tended to shrink. The newest sections were the largest.

This disappearing section had been small when new. It had housed only Gavving and Minya and the baby Rather. Other children had come, and Gavving wove new rooms eastward, faster than the treemouth could swallow them. By now there were seven children, and a new wife for Gavving, and a far bigger common room; for the Citizens Tree populace was growing too. The original rooms had disappeared into the treemouth. These that he was passing now, wicker cages alongside the tunnel, were still less than Rather's height. The children tended to claim these for their own.

Rather found a deformed door. As he crawled inside he heard Minya saying, "Keep going, Carlot. Go to the common room and get my old matchet off the wall and bring it back. Hurry."

Harry, eight years old and Rather's height, was crying into Mishael's chest. Rather nodded to Mishael. "Second Mother. Which way did he go? Straight west?"

Misheal, seven years older than Carlot, had Carlot's dark, exotic beauty in fully developed form, and legs that caused even Rather to stare: long and slender and perfectly matched. She'd cut her trousers into loose shorts, odd-looking in Citizens Tree. The low roof cost her some dignity. She had to crouch. She looked uncomfortable and annoyed. "Straight on in. And he's stopped talking. I think he's mad at us."

Rather said, "You know this is no big deal, don't you? It happens all the time."

"I *don't* know. Rather, I still get the shivers in your crawling huts! Your parents just don't understand that. And poor Gorey, he is frightened."

"Sure. Carlot's coming with Mother's matchet. Send her after me. I need it to cut my way through." It didn't feel odd to be speaking thus peremptorily to his second mother. Mishael wasn't that much older than Rather; she was new to all this, and it showed.

Rather crawled west.

Memories tried to surface around him. His parents' bedroom: he'd lived in a basket, in a corner too small for a baby now. The private dining area, and ghosts of wonderful smells: were they in his nose, or in his mind? The common room, and too many strangers: he'd cried and had to be taken away. The spaces were distorted and tiny, a green-black womb. The spine branches were still growing. He tore them away with his fists; tore through an old partition.

He didn't like this. His past was too small to hold him. "Gorey!"

From west by north, Gorey yelled piercingly. He sounded more angry than frightened. How had he gotten *there*? What had been a kitchen wall had crumpled and grown half a meter thick! He must have found some way around—

"Rather?"

Carlot, behind him. He reached far back and took what was pushed into his hand. "Thanks." He pulled it to the level of his face, turned it with some difficulty and pushed the blade further.

"Can you get to him?"

"One way or another."

For years the matchet had been no

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more than a part of the wall. He'd never really looked at it. The handle was long and a bit too wide for his short fingers. The blade was sixty ce'meters of black metal, tinged red by time. Time and use had serrated the edge. It had once belonged to a Navy man of London Tree.

In this restricted space he must use it as a saw. He didn't try to cut the wall. He cut branchlets west of him. He turned starboard, still sawing through miscellaneous branchlets. "Gorey?"

Cautiously, doubtfully: "Rath?"

"Here. Give me your hand. Can you reach me?"

"I can't move!"

Rather saw a thrashing foot. He pulled on it experimentally. Gorey was pinned between a spine branch and a smooth dark wall: the main branch itself. He must have tried to crawl between them. Rather wriggled forward. He sawed the spine branch half through, reached further and broke it with his hands. Gorey wriggled out and wrapped himself around his brother and clung. Presently he asked, "Are they mad?"

"Sure they're mad. How did you get here? Hide and seek?"

"Yeah. Harry said he was gonna catch me and feed me to the triunes, so I kept going. Then I was afraid the treemouth would get me and I got *really* scared."

"Harry wouldn't get that close to a triune family. You know that."

"Yeah, but I was mad."

"You'd starve to death before you reach the treemouth. Here, grab my foot and follow me."

The boy's fingers were long enough to overlap Rather's ankle. He was already taller than Rather. They crawled out, with easier going at every meter.

In the common room Rather's mothers greeted him as a hero, while Gorey was scolded and petted. Rather took it with what grace he could. He wondered if Carlot was laughing at him; but in fact she seemed to think he had done something actively dangerous.

It made him uncomfortable. He was vastly relieved when Gavving poked his head through the door. "Treadmill runners!" he called. "Rather?" And Rather was rescued.

Harry and Carlot came with them. As they neared the treemouth Gavving said, "Harry, Carlot, why don't you see if they need help with the laundry pot?"

They split off, Harry grumbling.

Rather followed his father up through the tunnels toward the treadmill. His nerves were prickling. Something odd was going on. "Father? Do they really need treadmill runners?"

"No," Gavving said without looking down.

The treadmill was at rest. Debby and Jeffer lay in the foliage nearby, eating and talking. They sat up when Gavving appeared. "Got him," Gavving said.

This must have something to do with the Serjent family; and the conference before the last sleep, from which children were barred; and the arguments that divided half the families in the tree. *Do my mothers know about this? Would they approve?* Rather asked instead, "Should we have brought Carlot?"

"No need. Rather, we have to find out something." Gavving pointed at a short, faceless fat man made of silvery metal. "Try that on."

"The silver suit?"

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"Yeah. See if you can get into it."

Rather looked it over. This thing had a fearsome, quasi-scientific reputation. It was a flying fighting machine, stronger than crossbow bolts, stronger than the airlessness beyond all that was known. Rather had never before seen it with its head closed.

Jeffner instructed him. "Lift this latch. Take the head and turn it. Pull up. Turn it the other way."

The head came up on a hinge.

"This latch too. Now pull this down . . . now pull it apart . . . good."

The suit was open down the front, and empty.

"Can you get in?"

"Where's Mark?"

"Debby?"

"No problem. We relieved him and he took Karilly to the kitchen."

"Father . . . wait. Listen. I'm the only boy in the tree with two mothers and two fathers." Rather plunged on despite the sudden hurt in Gavving's face. "We've never talked about this, but I always knew . . . sooner or later I'd . . . does Mark know what you're doing with the silver suit?"

"No."

"What's it all about?" Four big adults could make him do whatever they wanted; and it didn't matter. They needed his cooperation, and he didn't know enough to give it.

Jeffer the Scientist said, "It's about seeing what's outside Citizens Tree. It's learning about the Smoke Ring, what we can use, what we need to be afraid of. Or else it's about staying savages until someone comes out of the sky to teach us the hard way."

"We're going to the Clump," Gavving said. "We'll be safer if we can take the Silver Man."

"Uh-huh. Mark doesn't want to go?"

"Right."

They watched as Rather tried to get into the suit. He had to get his legs in first, then duck under the neck ring. He closed the sliding catches, the headpiece, the latches. The suit was loose around his belly, snug everywhere else. "It fits."

Jeffer closed the helmet on him. He rotated it left until it dropped two mi'meters, then right.

Rather was locked in a box his own size and shape. The suit smelled faintly of former occupants, of exertion and fear. He moved his arms, then his legs, against faint resistance. He turned and reached and plucked a handful of foliage . . . good. He could move. He could move like a normal man.

The air was getting stale . . . but Jeffer was already turning the helmet, lifting it. The adults were smiling at each other. Gavving said, "Okay. Get out of it."

Getting out of the silver suit was as difficult as getting in. Rather said, "Now tell me."

"Some of us are going to visit the Clump. Do you want to come with us?"

"Who's going? How long will it take?"

"Me," said Jeffer. "Gavving. Booce and Ryllin. Anthon and Debby. The Clump is all jungle giants. We need people that size."

"How does the Chairman—"

"He'll try to stop us."

"Father, I don't really like the thought of not ever coming home."

Gavving shook his head. "They'll

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want the carm back. They'll want us back too. Citizens Tree isn't so crowded that they can afford to lose anyone who breathes. They'll want to know what we learned. They'll want what we bring back. Half the citizens are on our side, anyway; they just don't want to buck the Chairman."

"You're taking the *carm?*"

"We are." Gavving clapped him on the shoulder. "Think about it. We've got two sleeps to get ready. Whatever you decide, don't mention this to anyone, particularly your mothers."

"Father, you'd better tell it all." Rather didn't consider whether he had the right to ask. Clave wouldn't like this; Minya wouldn't like it; and if he agreed to this—it was only just coming to him—if Rather agreed, then *he* was the Silver Man.

Jeffer said, "It isn't just the wealth of the Clump Admiralty. It's—"

"Tell me *what* you're going to do." They told him.

Chapter Six: The Appearance of Mutiny

From Discipline*'s log, year 1893 State = 370 SM:*

> Medical readouts showed that the inhabitants of CARM #6 lied to me. They reacted strongly to accusation of mutiny. I lost my chance to question them in detail. They may have mutinied against legitimate holders of the CARM. Heredity will tell.
>
> It's a bad habit. I will break them of it.
>
> —Kendy, Checker

Clave pulled himself out of the elevator first. Wings were tethered next to the cage, and he pulled one free and tied it in place along his left shin. "This was a good idea, Gavving. Wings aren't much use in the tuft."

"Oh, we'll keep some there, too. Hunters used to carry jet pods. Wings are better. But there's no point porting them up and down every time someone wants to fly. What are you doing?"

"Fixing this." He chopped with his machet at his other wing. When ten ce'meters were gone, he tied the wing to his right shin. He felt distinctly lopsided.

Jeffer and Gavving were also winged now. The three flapped out toward the carm, spurning the convenient handholds the bark afforded. Clave's flight wavered, then steadied. He'd been right. This was easier on the warped muscles in his thigh.

Jeffer was first through the airlock. "Prikazyvat Voice."

The carm's deep voice said, "Ready, Jeffer the Scientist—"

A woman's voice broke in. "Jeffer, it's Lawri. I think I want to join you."

"Come on up. Bring something to eat. We'll be running the main motor for maybe two days."

"Will do. Lawri out."

"What was that about?" Clave asked.

"Lawri doesn't trust me with the carm." Jeffer laughed. "Now we refuel the beast."

Clave sighed. "Pump?"

"Right. You pump while I do a checklist. Otherwise we'll lose the pondlet when we go under thrust."

Some pumping had been done, but tons of water still nestled against the trunk. Clave ran the hose from the carm

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to the pondlet. The pump was a wheel and a tube and piston, all carved from hard branchwood. Clave braced his back and arms against the bark and kicked the wheel around with his feet on the spokes. "Help would be appreciated," he grunted.

Gavving joined him.

The pump leaked. The pond didn't dwindle fast, but it dwindled. They broke to drink thirstily, then resumed pumping. The sun had dropped from zenith to nadir— which at the mid-year was not behind Voy, but north by three full degrees— when Jeffer poked his head through the airlock. "Stop! The tank's full!"

Clave tossed his head to shake some of the sweat out of his hair.

"Come inside." Jeffer ushered them forward to the front row of seats. "Strap down."

He tapped, and vertical blue dashes appeared in the panel below the window. Four clusters of four each at the corners of a square, and a larger dash in the center. He tapped the central dash.

The sound within the cabin was like the roaring of wind at the treemouth. Clave felt a featherweight of tide, and knew the tree was in motion.

Jeffer told them, "We're already placed right, with the motor aimed west. We thrust eastward. That puts Citizens Tree in a wider orbit, so we slow down and drift west, away from the Clump."

Clave wondered if he wanted to watch from outside. "Is it dangerous out there?"

"Could be. You don't want to fall into the flame. Anyway, the view's better in here." Jeffer's fingers danced, and the carm window sprouted five smaller windows. "The ventral view got ruined when we fell back into the Smoke Ring—"

"Jeffer, you don't lecture this much unless you're nervous. What's wrong? We've moved the tree before."

Gavving laughed. It appeared that he had a touch of nerves too. "Remember how twitchy we were then? Merril was sure we'd break the tree apart and kill ourselves."

Clave shrugged. He went aft and braced himself in the airlock.

What remained of the pondlet stretched itself out from the trunk, then broke into one big drop and a line of little ones. The mother pond they'd robbed twenty-two sleeps ago drifted west. The sun passed Voy and began to climb. A fat triple-finned bird, dead west by a klomter or three, suddenly went into an epileptic seizure, split into three slender birds, and scattered. Clave was late in understanding what he'd seen: a triune family suddenly washed by the invisible heat of the carm's exhaust.

Clave went in and strapped down again.

He had been anticipating Lawri's arrival for some time, but the carm's roar covered her entry. He turned to see her halfway up the aisle . . . and Debby behind her. And Ryllin. And Booce and Carlot. Clave fumbled to release the buckle that bound him to the chair.

It took too long. He was between Jeffer and Gavving, with Lawri behind him. He sighed. "What's it all about?"

Jeffer's fingers danced. The board went blank. He said, "We can fight or we can talk. Or we can talk and then fight, but there's only one of you,

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Clave. Cripple me and Lawri flies the carm."

Call for help? If he could get past Jeffer to use Voice, the elevator would still take a day to get up . . . forget it. Voice connected to the silver suit, which Rather was now pulling headfirst through the airlock.

It would have felt good to hit somebody. Clave said, "I'll be good. Now what's it all about?"

"We're going to visit the Admiralty," Jeffer said.

Rather and Booce were moving things inside: two smoked turkeys, a huge amount of foliage, water pods.

"All of us?"

"Not you, Clave. Lawri's staying too. Citizen Tree needs a Chairman *and* a Scientist."

"How did you decide—"

There was a bit of an edge in Lawri's voice. "We knew one of us would have to stay. Now I've missed my time of blood. I'm hosting a guest. I wondered why the copsik was being so affectionate."

"You should all be staying. You're taking the carm?"

"The carm, the silver suit, and the pipe from *Logbearer*."

They all looked very serious. The background roar prompted Clave to ask, "Are you planning to set the tree moving first? Or was that a lie too?"

"We'll give you a day's thrust," Jeffer said. "No more. I won't be here to decelerate you, and I want to be able to find you again."

"With what? Would London Tree have let you keep the carm? The Admiralty won't either!"

Patiently Gavving said, "We've talked that over. We won't take the carm into the Clump. They'll never know it exists. Jeffer will hide the carm somewhere. The rest of us will go in as loggers, with Booce and Ryllin to show us how."

Clave's mind was racing. "Now listen to me. Will you listen?"

"Yes, Chairman."

"First, are you all volunteers? Rather, how did they suck you into this?"

"They can't go without the silver suit," the boy said.

"Oh, they'd go. Wouldn't you, Jeffer?"

"Yes."

"I'm going anyway," Rather said.

He didn't look like he'd change his mind. Rather didn't even bother to argue, though the boy was good at that. Clave knew how *he* would enlist a fourteen-year-old boy. Put him in the silver suit, call him the Silver Man, offer him status and adventure . . . "Carlot?"

"I'm going home," the girl said defiantly.

"Debby?" But a glance told Clave he'd lost that battle. Debby was fiercely happy. He hadn't seen her like this since the War of London Tree. "What about Anthon?"

Debby said, "I never told him. Jeffer, I did get him talking. He likes Citizens Tree just fine and he doesn't want any changes. Have you noticed how fat he's getting?"

"Too bad," Jeffer said.

Clave said, "Stet. I accept that you're going to do this. I've heard your speeches, and you've heard mine, and the treemouth can have them both. But don't you see that this will tear Citizens Tree apart? It's mutiny. Hold it! I mean it's mutiny the way you've planned it.

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If we don't fix that, Citizens Tree will never recover. It's got to look better than it does."

The mutineers looked at each other.

"Here's how it's got to be," said Clave. "First, I'm going. Gavving isn't. You said it and you're right. The tree needs a Chairman and it's Gavving."

Gavving said, "That's silly. You're—"

"I'm the treefeeding Chairman, and if I go the expedition is official. Besides that, I've got to see to it that you return the carm and the silver suit. The citizens would be crazy to settle for less. I hereby appoint you my Chairman Pro Tem until I return."

Coolly Gavving asked, "Anything else?"

"Yes. You don't get both Booce and Ryllin. One of them stays. There has to be some reason for the Serjents to bring us home."

"We can't do that," Ryllin said. "Booce takes care of *Logbearer*. I take care of business. I do all the buying and selling. Anyone who sees one of us in the Clump will expect to see us both."

Clave was massaging the lump on his thigh. Sometimes that helped him think. *Think!* "The citizens you deal with, the . . . merchants? If they deal with Booce, what will happen?"

Ryllin said, "My husband is very good with machinery, not so good at trading. He did much better after he had the good sense to marry me. But *Logbearer* understands him, he—"

"Without you they'll get a better trade?"

"Damn right they will," Booce said bitterly. Then, "Yes, they will."

"They'll like that? They won't be too curious about where their luck comes from?"

It was Ryllin who nodded. "It's all right, love. Think of a story. They'll want to believe it."

"But we're missing three daughters too!"

"The house. They must have finished building our house by now. The girls and I are with *Logbearer* or we're at the house, wherever you're not. Maybe I'm somewhere in the Market buying furniture. That was the whole point of this last trip, we were going to—we were—" She turned away suddenly.

Emotional displays weren't needed here! Clave said, "We're not hiding anything but the silver suit and the carm. Otherwise we can tell any story we want. What's next? Gavving, Lawri, Ryllin, you back each other up when you go back to the tuft. Whoever's asking, the Chairman had to be talked into this, but I did agree, and I put the fine details in."

Rather called from aft. "Jeffer, the pipe's moored to the hull. We've got everything else, but it all has to be moored."

"Go ahead. I'll check you later. Gavving, are you willing?"

"Treefodder. Well, it'll probably keep Minya from killing me. . . . Clave, will this work? Is it enough?"

"Only if we come back. We come back with the carm and something else too. It almost doesn't matter what."

"Stet. I'm the Chairman Pro Tem."

Jeffer killed the main motor. "Somebody go out and get our lines untied."

Rather went. Debby joined Booce aft.

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They began mooring what remained of the cargo: two big hooks, spare clothing, sacks of undyed cloth, harpoons, crossbows.

Lawri said, "Jeffer, let me show you something." She eased up next to him and tapped at the controls, whispering. Her shoulder blocked Clave's view. Clave's mind still raced, seeking flaws . . . he was looking for holes in a harebrain net! There was no way to make mutiny smell sweet.

"Are we bringing the spitgun? No, of course not." The weapon Mark had been carrying when he was captured was now in custody of the Chairman. "Gavving, it's in the older part of my hut, what used to be the common room. If you don't have the spitgun you're not the Chairman. Get it before anyone notices."

Rather scrambled back through the airlock. Gavving, Ryllin, and Lawri left. Jeffer let them get well clear before he pulled away on the little jets.

The tree receded. Three tiny citizens fluttered toward the elevator dock. A cage had nearly reached the dock. One of the occupants was shrieking and waving its fists.

"Somebody must have found Mark," Debby said. "Relax, Clave, we only tied him up."

"Yeah. But if I'd known a rescue party was coming . . . skip it. You'd have closed the airlock in their faces. I hope you treefeeders can find something worthwhile in the Clump. It's *my* reputation on the line now." ■

CONTINUED IN NEXT ISSUE

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Ian Stewart

THE ELECTRONIC MATHEMATICIAN

Mathematicians have always dreamed of having machines that would remove the drudgery from their work. The inventor of logarithms, John Napier, also invented a system of carved ivory rods for doing long multiplication, known as "Napier's Bones." Blaise Pascal built the first mechanical calculator in 1642. In 1835 Charles Babbage designed a calculating machine that could modify its own instructions—a key step toward today's computers—but although a lot of money was spent, the machine was never completed. Two of the true Fathers of the Computer, John von Neumann and Alan Turing, were mathematicians.

Perversely, now that we *have* computers, they have largely been neglected by those most deeply concerned with mathematics *as* mathematics: the Pure Mathematicians. It is the consumers of mathematics, such as scientists, engineers, economists, and statisticians, who find the computer indispensable.

Suddenly, this picture is beginning to change; and the reasons have as much to do with the growing abilities of computers as with changes in the attitudes of mathematicians.

Number-Crunching

Until about the 1970s, computers were seen as glorified calculating machines. Both their designers and their users tended to have backgrounds in the "hard" mathematical sciences. A tremendous number of scientific problems can be reduced to long sequences of routine arithmetical calculations: the practical problem is to perform these rapidly and accurately.

For example, one way to work out the orbit of a Moon rocket is to imagine time moving in tiny clicks, say a thousandth of a second long. Between one click and the next, the rocket moves according to the forces of gravity that act on it; and since the time interval is so short, these forces do not change significantly during the motion. It is then

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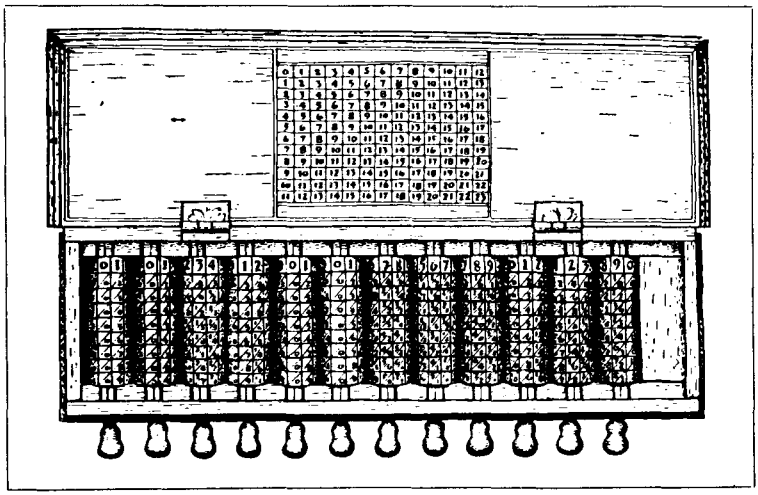

Figure 1. Napier's bones—an early calculating machine, the first advance on the abacus. Picture: *Scientific American.*

entirely straightforward to work out where the rocket moves to. The trouble comes when you want to string together the 250 million or so clicks needed to follow the rocket to the Moon. The computer is ideal for this kind of game. Even the earliest computers were better at it than humans. And now we are in the Age of the Supercomputer.

There are several ways to measure the speed of a computer. One uses MIPS (Million Instructions Per Second). This tells you how many things the Central Processing Unit does in a second—but different CPUs can do very different things, so it is only a rough guide to performance. Another yardstick is the *flop*, or floating-point operation. In decimal notation, a floating-point number is one in "scientific notation" with a decimal point and an exponent, for example 6.626205×10^{-34} or 2.6751978×10^{8}. In the computer the actual representation of such a number is in binary, with a power of 2 rather than of 10, but that need not concern us. A flop is one arithmetical operation carried out on such a number (accurate to, say, 15 decimal digits). A speed of one *megaflop* corresponds to being able to perform one million flops per second.

The earliest supercomputers, the Cray-1 and CDC's Cyber 205, had average speeds of about 20 megaflops, increasing to 100 megaflops under favorable conditions. For many applications this is a minimum requirement—for example it takes a Cray-1 about 4 hours to predict the weather one day ahead. Its replacement, the Cray X-MP, is about eight times faster, and the Cray-2 will surpass one *gigaflop* (billion flops per

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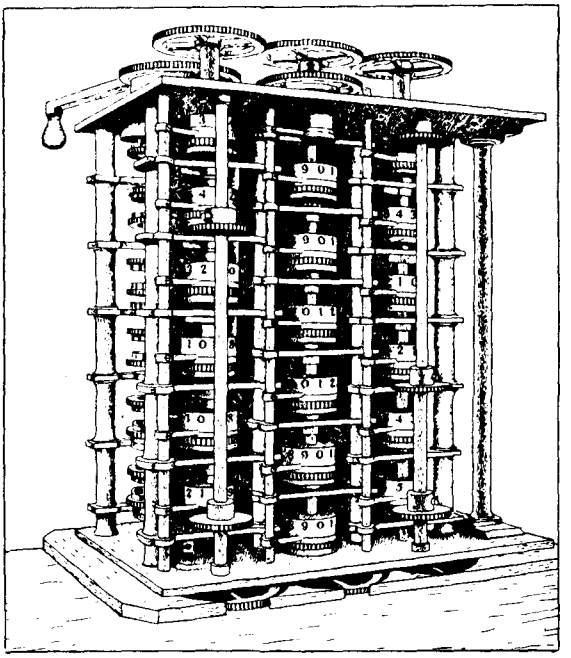

Figure 2. Babbage's Analytical Engine. Despite lavish funding from the British government, it was never built. Picture: *Scientific American.*

second). The latest offering from CDC has eight linked CPUs and a speed of 10 gigaflops (at a price of $18 million). For comparison a typical home computer might manage between 100 and 500 flops.

New developments will push these figures higher. The British company Inmos has recently developed the T414 transputer—a "computer on a chip" with a speed of about 10 MIPS. The great strength of the transputer is that arrays of them can easily be linked together. There is an array (costing $5000) that can speed up an IBM PC by a factor of 10, and another that can match the performance of a VAX. A prototype machine called the "Computing Surface," using 150 transputers, has a speed of 1200 MIPS, about 40% of the speed of a Cray X-MP. A thousand transputers could outdo a Cray. Ten thousand? Who knows?

This sort of computing power can crunch numbers to an extent undreamed of a decade ago. But calculations of this kind are directed toward very specific questions. "Given the current pattern of the world's weather, what will be the rainfall in Barcelona at 11:43 A.M. tomorrow?" They are much less helpful with general questions, such as "What

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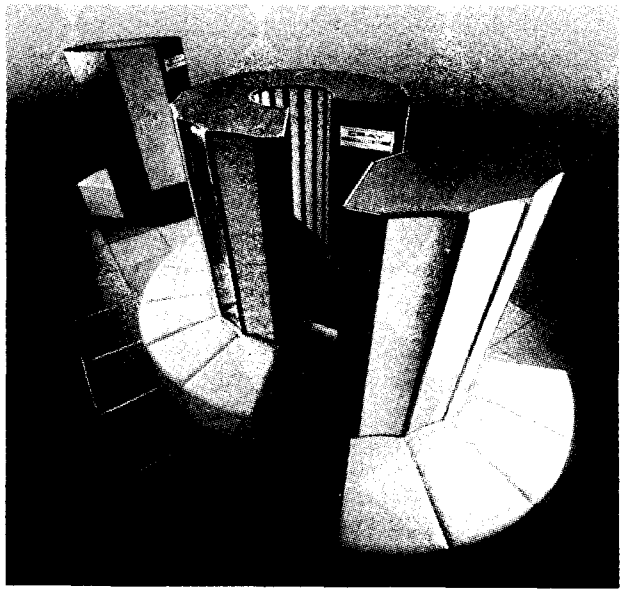

Figure 3. The Cray-1 supercomputer. Courtesy of Cray Research Inc.

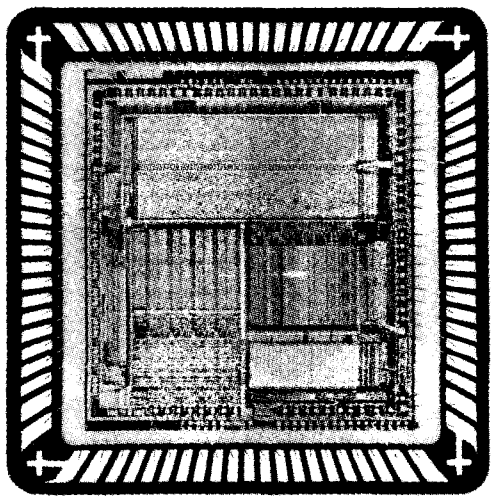

Figure 4. The Inmos IMS T414 transputer—a computer on a chip. Photo: Inmos.

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are the conditions that give rise to hurricanes?''

The Pure Mathematician isn't much interested in special problems. He wants to *understand* a phenomenon, not *work out* an answer. (I'm not suggesting that one of these is better—merely that they are different.) Understanding a phenomenon is a conceptual problem that even in principle does not seem to reduce to routine calculations. One of the greatest mathematicians who ever lived, Carl Friedrich Gauss, once remarked that mathematics was about ''Notions, not notations.'' That is, ideas, not calculations. (This didn't stop his working out the orbit of the asteroid Ceres, running a geodetic survey, and inventing the telegraph: he had a practical mind as well as being a deep thinker.) The general feeling among Pure Mathematicians was that once you could understand a problem well enough to put it into a form that the computer could handle, you could probably finish the job yourself with a little extra effort.

The MU-Puzzle

This may sound a bit arrogant. An example, based on the MIU system invented by Douglas Hofstadter in his book *Gödel, Escher, Bach* helps to make the reasoning clearer.

The artificial language MUD has only three letters (M, U, and D). Some combinations are ''grammatical'' and make permissible *words*; some do not. The rules of the grammar are:

1. If a word ends in D, you can add U to get another word.
2. If a word starts with M, you can double up the part that follows the M (so for example MDU gives MDUDU).
3. Any occurrence of DDD can be replaced by U.
4. Any occurrence of UU can be dropped altogether.
5. MD is a word.

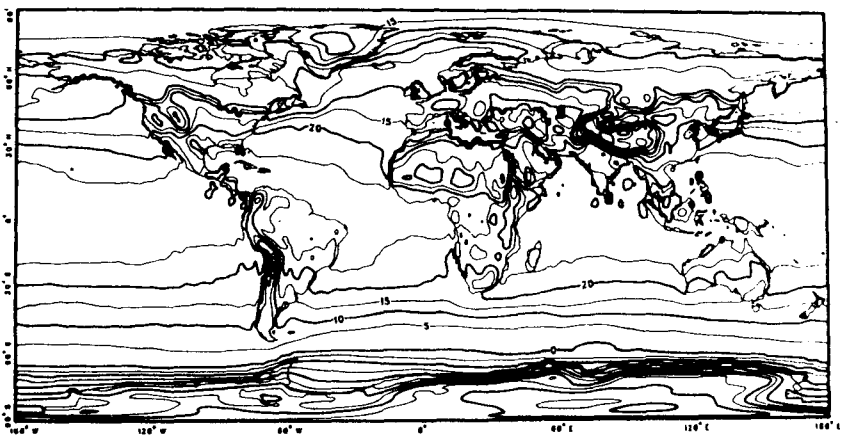

Figure 5. World weather map, prepared using a Cray X-MP supercomputer. Picture: European Centre for Medium Range Weather Forecasting.

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For instance, starting from rule 5 with the word MD we can use rule 2 twice to get MDD and MDDDD; then use rule 3 to get MUD, then rule 1 to get MUDU, then rule 1 to get MUDUUDU, then rule 4 to get MUDDU; and so on.

The question is: is MU a grammatical word?

Before reading further, try to solve this yourself. You'll get a better feel for the MUD rules that way. You'll also find (unless you make a mistake) that MU is extremely elusive.

Now let's think of a computer approach. The only possible place to start is with MD—that's the only word we're given to start from. We instruct the computer to try out all possible uses of rules 1–4 on this word and to list all the resulting words; then to try out all the rules on those; and to keep going, all the while looking for MU. If it finds MU, it should stop and tell us the steps involved.

That's fine, but what if MU cannot be reached at all? Then the computer never stops; but we don't know this, because at any stage, there's just a faint possibility that the very next try will succeed! To show that MU is impossible, we're asking the computer to carry out an infinitely long computation, and this is beyond the power even of a Cray-1.

So routine word-crunching may not be able to solve the problem at all. And in fact, it won't. Let's try using those little gray cells: "Think first, Program later."

A MU-Sing Solution

(That's a polyphonic pun which you can dissect at leisure.) The number *two* is firmly built into our consciousness: we have words like "even" to mean a number that is divisible by two, and "odd" to mean one that is not. The key to the MU-puzzle is to think similarly about the number *three*. There aren't any ready-made words, so I'll borrow some. Call a number "treble" if it is divisible by three (reasonable enough); and following a false analogy, call it "soprano" if it is 1 higher than a multiple of three, "bass" if it is 1 lower. So 15 is treble, 16 is soprano, and 14 is bass. In fact every number falls into exactly one of these three types.

Given a word in MUD, count the number of D's that occur, and say whether the word is treble, soprano, or bass depending on what that number is. For example, the starting word MD is soprano, because the D-count is 1. (Zero is a multiple of three.) Now think about the rules, and what kinds of word they produce. Rules 1 and 4 make no changes to the type at all. Neither does rule 3: it reduces the D-count by 3, which never changes the type.

Rule 2 is the interesting one. If the original word is treble, it stays treble. If it is soprano, it becomes bass; if it is bass, it becomes soprano. (MDU is soprano, MDUDU bass.)

There is no way to produce a treble word out of a non-treble word. And, since the only starting point is MD, which is soprano, the rules can never lead to any treble words. In particular, they can never lead to MU (with D-count zero). So MU is not a grammatical word.

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Not only have we been able to avoid the massive series of routine calculations originally envisaged in a computerized approach: we've actually solved the whole problem in our heads. And we've done it by noticing some special element of structure in the problem, one not obvious at first. It even generalizes: for example, MDDD can't be grammatical either, for the identical reason that it's treble.

This is a deceptively simple solution. It's so easy to follow, once thought of, that the whole problem starts to look simple too. But thinking of the main idea—that's the hard part. With most pure mathematical problems, it's not at all clear *how* to restate them in a form suited to computer analysis; and doing that is most of the battle.

Are Four Colors Enough?

One really striking success for the computer as pure mathematician came in 1972, when Kenneth Appel and Wolfgang Haken solved a long-standing problem in topology. It dates back to about 1840, although the earliest recorded statement is in a letter from Francis Guthrie to Augustus DeMorgan in 1850.

The problem is this: can every map drawn in the plane (i.e. on a flat sheet) be colored so that countries having a common border are given different colors, using only *four* colors altogether?

It sounds easy, and at first it seemed that it was, because A.B. Kempe solved it in 1879. Or so it was thought until P.J. Heawood found a subtle mistake in 1890. The most that could be salvaged from the wreck was a proof that *five* colors would be enough. On the other hand, nobody could think of a map that actually *needed* five. This left a tantalizingly narrow gap, and the problem slowly gained notoriety as one of the easiest-to-state and hardest-to-solve open problems in mathematics.

A direct attack by computer isn't feasible. It's not that the geometrical nature of the problem makes it unsuited to computer analysis: the essentials of the map can easily be stored as a list of its countries and another list of the pairs that are adjacent across a border. It's the same difficulty that we saw in the MU-puzzle. Exhaustive computer searches of possibly infinite collections of objects can *find* one having a certain feature, if one exists, but they can never show that there are no such objects at all. However long the search has gone on, there is always the faint chance that one more try will succeed.

Appel and Haken's idea was to follow Kempe's basic strategy, but avoid his tactical errors. Roughly, the strategy was this. Make a list of possible "submaps," complicated enough so that every map that needs five colors has to contain within it something on the list. Then show that because it contains something on the list, it doesn't need five colors after all! Kempe's list satisfied the first condition, but not the second. Possibly some other list might be found that satisfied both.

Educated guesswork shows that it has got to be a pretty big list. Kempe tried a list of five maps; Appel and Haken

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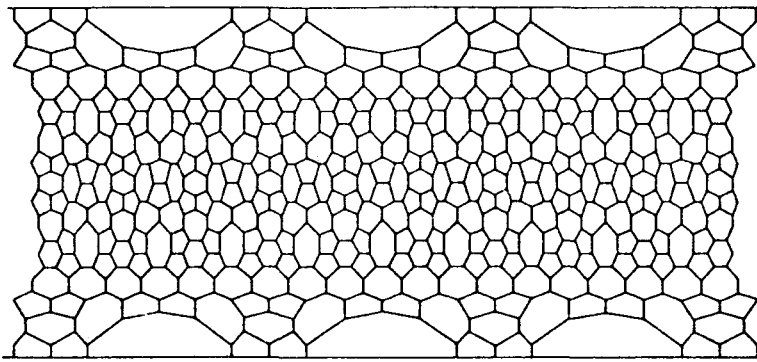

Figure 6. One of a series of maps devised by E.F. Moore to show that a simple proof of the Four Color Theorem is unlikely to exist.

ended up with 1,936. They were able to show *without* invoking a computer that the list covered all eventualities (in itself a breathtaking feat). But to rule out each of the 1,936 submaps required enormously complicated case-by-case checks that could run to days or even weeks by hand. Worse, if any submap could *not* be ruled out it would have to be removed from the original list, and replaced by a whole lot of even bigger maps. The entire calculation chased its own tail, and succeeded only if it caught it. The final computer run took about 1200 hours on a fast machine.

What I find more interesting is the process that led to the list. It involved a four-year collaboration with the computer in which various lists were tried, modified, or discarded; and during which Appel and Haken began to gain a "feeling" for what would or would not work. It's not something that can be explained to anyone else on paper; but it's demonstrated by the fact that they wrote down the final list by hand, and proved it was able to cover all possibilities. They were using the computer as a kind of experimental instrument.

Some mathematicians are still unhappy with the statement that the problem is "really" solved. This is because no human mind could actually carry out all the steps needed to check it. But there are plenty of precedents in man-made mathematics: many results are proved by the collaboration of dozens or hundreds of mathematicians, and no one of them is capable of living long enough to be absolutely certain that the others have made no mistakes. After all, it took ten years for Kempe's error to come to light, and it wasn't an obvious one.

However, there are two obvious precautions to be taken. First, is the computational strategy correct? That can be answered by reading the computer program, and is no different from reading a mathematical proof in a journal. The other is: to be as sure as possible that

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the computer is actually behaving the way its manufacturers think it is. Appel and Haken were sufficiently worried about that to investigate the detailed operating system of the computer—and in doing so found several errors which no other users had spotted.

There is still a "philosophical" question about computerized proofs. But the pragmatic view is that provided the program and the operating system seem all right, the computer is much less prone to error than we are. If I wanted to guarantee that this article had no spelling mistakes, I'd trust a computer's word more than I would a human's. . . .

Simple Groups

There is one branch of mathematics with somewhat "artistic" leanings, which deals with symmetry. A symmetry of an object is a way of moving it so that at the end it occupies the same region of space as before. If you rotate a square through a right angle, it looks exactly the same—unlike a rotation of 45° which leaves it tilted like a diamond. Other symmetries of the square are possible: rotations of 180° and 270°, four different ways to flip it on to its back —and a trivial symmetry: leave it alone. There are exactly eight symmetry motions in all.

The set of all symmetries is called a *group*, because its members have a habit of sticking together. More precisely, if any two symmetry motions are performed in turn, the result is another of them. Rotate a square 90°, then 180°: this gives a combined effect of a 270° rotation—still in the group. The group has a kind of internal multiplicative structure. A generalized study of this phenomenon is called Group Theory.

Group Theory began in about 1820, and was fairly abstract even then, when orthodox tastes were more concrete than now. In the early 1900s the physicist James Jeans and the geometer Oswald Veblen were discussing the Princeton curriculum. "We may as well cut out Group Theory," said Jeans; "that is a subject which will never be of any use in physics." Seldom has anyone been so drastically wrong: most of today's theories of subatomic particles would be impossible without the language and ideas of Group Theory. Symmetry principles run very deep in nature, and Group Theory is the natural language of symmetry. Its influence is becoming very strong in many areas of science.

The number of symmetries that make up a given group is called its *order*: the symmetry group of the square has order 8. Most groups are much bigger. The usual method for understanding big things is to break them down into lots of smaller things, and mathematicians have applied this technique assiduously to groups. It's a bit like chemistry: a molecule (big group) is broken up into atom (smaller groups) and the main task is to understand the pieces, and how to assemble them.

The atoms of Group Theory are called *simple groups*. The adjective means "not composite" here—there's nothing easy about simple groups, which can be unimaginably complicated. A major achievement of this century's mathematics has been the complete determi-

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nation of *all* possible simple groups. In our chemical analogy, this is like finding the complete periodic table of the chemical elements. A list of those involved would be a *Who's Who* of Group Theory: the final proof occupies some 20,000 journal pages. Almost all of the work has been done by hand; but there have been crucial contributions from the computer.

The actual answer is most curious. There are an infinite number of huge families of simple groups, each having a very similar structure. All very neat and tidy, except that there are also 26 weird exceptions, the *sporadic groups*, with no pattern to them whatsoever—yet. They have been discovered by an amazing variety of methods: a few in the late 1900s, most between 1960 and 1980.

Even more amazing is the *size* of the brutes. The largest, affectionately and rightly dubbed The Monster, has order 808,017,424,794,512,875,886,459,904 961,710,757,005,754,368,000,000,000: roughly one septemdecillion (if there is such a word) on the American system of millions, billions, trillions, and so on.

The biggest problem with the sporadic groups has been whether they really exist at all. The methods that produce them generally begin by providing a lot of "clues" as to what is or is not possible. Slowly more and more of the structure appears; and if there's really a group at all, it seems to hang together consistently. But no amount of apparent consistency can decide existence.

However, sometimes the computer can. The sizes are so vast that all sorts of clever shortcuts have to be used. But several mathematicians, notably John McKay, have successfully verified the existence of sporadic groups by computer calculations.

The Monster has proved especially intractable: it's far too big even for the biggest computers and the slickest shortcuts. It was one of the last gaps in the puzzle to be filled: in 1981 Robert Griess managed to prove that it really did exist.

By hand.

Shuffling Symbols

So far I've described areas where the mathematics is moving in a direction that is unusually suited to the computer's talents. But there have also been improvements to computers that make them more suited to mathematics.

First there is the hardware—the actual circuitry. The machines are faster, more powerful, and have a far bigger memory. Pure mathematics can use up an awful lot of memory. But the most interesting improvements have been to the software—the programs that tell the computer what to do. (Think of the computer as an orchestra: better hardware means sweeter violins; better software means Beethoven instead of Three Blind Mice.)

Computers aren't really *number*-crunchers at all—they've just been built that way. Numbers are of course needed in most computerized tasks: even a typist has to center headings and count lines. But basically a computer is a device for processing information, and the *kind* of information doesn't matter much.

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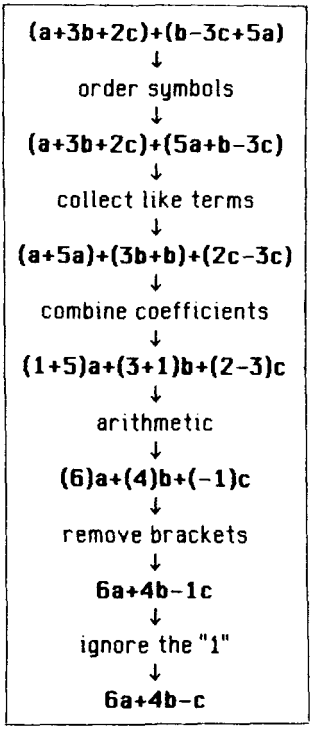

Figure 7. Algebraic calculations are made by using a series of elementary operations. A computer can be programmed to carry them out, rapidly and accurately, on complicated expressions.

Computers have to be taught to do arithmatic: it isn't natural to them. The business world has generated a supertypewriter, the word processor, that crunches *words*. And there now exist systems that crunch symbols: Computer Algebra.

The basic problem is to find good ways to represent mathematical expressions in the computer, and to list the formal rules used to manipulate those expressions. Figure 7 shows several stages in an algebraic calculation, broken down into steps that could be programmed into a computer. In principle any set of rules could be fed into the computer, and it would then be able to carry out any specific series of calculations, however complicated, rapidly and accurately.

There are now several Computer Algebra systems available, of which the best known are MACSYMA, REDUCE, SCRATCHPAD, and SMP—all produced in the United States. But there are many others. The Russians have one called ANALITIK that is implemented

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in hardware. General-purpose systems include MATHLAB-68, SYMBAL, FORMAC, and SYCOPHANTE. There are also specialized systems rejoicing in names like TRIGMAN, SCHOONSCHIP, ASHMEDAI, and SHEEP, which do things like Quantum Electrodynamics. SHEEP is not an acronym, and its history deserves mention. It began as ALAM, meaning "**A** Lisp-based system for an **A**tlas **M**achine," was simplified to yield LAM, improved to CLAM (for the CDC-6600 series of computers), and then reached adulthood as SHEEP. No doubt its successor, **M**athematics via **U**niversal **T**echniques for **T**ransforming **O**perations and **N**umbers, is not far down the road.

One application is to the motion of the Moon, which is important in navigation and astronomy, and is surprisingly complicated. In 1847 the French astronomer Charles Delaunay began a calculation which was to take him ten years to finish, *plus* another ten to check: it led to a formula for the position of the Moon at any given moment. The formula occupies an entire book. In 1970 three researchers at the Boeing Laboratories in Seattle checked Delaunay's work on a computer, taking only twenty *hours*. They found only three tiny mistakes, none serious, which is almost incredible. Delaunay's virtuoso calculation is now a standard test for new Computer Algebra systems.

Why use computer algebra? The number-crunching approach to the Moon's motion is simply to tabulate the position for all the times of interest. This

Figure 8. A sample run of MACSYMA. The ODE2 package finds solutions of differential equations, here dy/dx + y tan x = sec x. TRIGSIMP simplifies trigonometric expressions. The symbol %C stands for an arbitrary constant.

```
(C1) LOADPRINT;FALSE$
(C2) Y:Y(X);
(D2)                    Y(X)

(C3) ODE2(DIFF(Y,X)+Y*TAN(X)=SEC(X),Y,X);
                              TAN(X) + %C
(D3)                    Y(X) = -----------
                                 SEC(X)
(C4) TRIGSIMP(%);
(D4)                    Y(X) = SIN(X) + %C COS(X)
```


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may tell you where the Moon will be, but it gives no insight into the reasons why. The aim of computing should be insight, not numbers; otherwise we shall end up able to calculate everything and understand nothing. Additionally, computer algebra can often simplify expressions before numerical values are attached, or suggest which terms are of negligible importance. Occasionally it is possible to attach numerical values, but to an unknown expression; so first the expression must be worked out algebraically. This is especially likely if the operations of the calculus are involved, because a direct numerical approach can be seriously inaccurate.

Even though it is still in a developmental phase, computer algebra has been applied to a variety of scientific problems. For example, the development of fusion power requires an understanding of magnetic plasmas. The equations governing these plasmas are extremely complicated and it is important to know which terms can be neglected without affecting the results. The Plasma Theory Group at the Massachusetts Insitute of Technology has used computer algebra to select the appropriate terms.

Another area of application is to the theory of gravitation, where possible variants of Einstein's General Relativity Theory are considered. In order to agree with experimental findings, these variants must satisfy a complicated theoretical criterion due to George Birkhoff. Computer algebra is well suited for applying this criterion.

In neurobiology a system of equations devised by the Nobel prizewinners Alan Hodgkin and Andrew Huxley model the propagation of a signal along a nerve. Under some conditions these equations can produce a repeated series of signals, known as a wamn. In order to test the stability of the wave train, it is sufficient to calculate the sign of a particular mathematical expression. Given the expression, a computer can easily feed in the actual numbers involved and evaluate it; but to produce the expression itself is an enormous task by hand. With computer algebra, it becomes a routine calculation.

All of these applications have one common feature: the desired calculation is *in principle* routine but in practice takes too long to be feasible by hand. But mathematics is not *just* routine calculations, and at its best it is the exact opposite. Setting up the equations for plasma flow, finding Birkhoff's criterion, establishing the condition for stability of a wave-train—these are where the mathematician truly earns his keep. There are plenty of problems that can no more be answered by symbol-shuffling than by number-crunching. The computer is becoming a valuable mathematical assistant, but it hasn't yet come close to putting the boss out of a job. Until a truly intelligent computer can be built, the computer will remain an assistant: mathematicians can probably breathe easily for the next few decades at least.

Graphics

Originally, most computers communicated their results through a kind of

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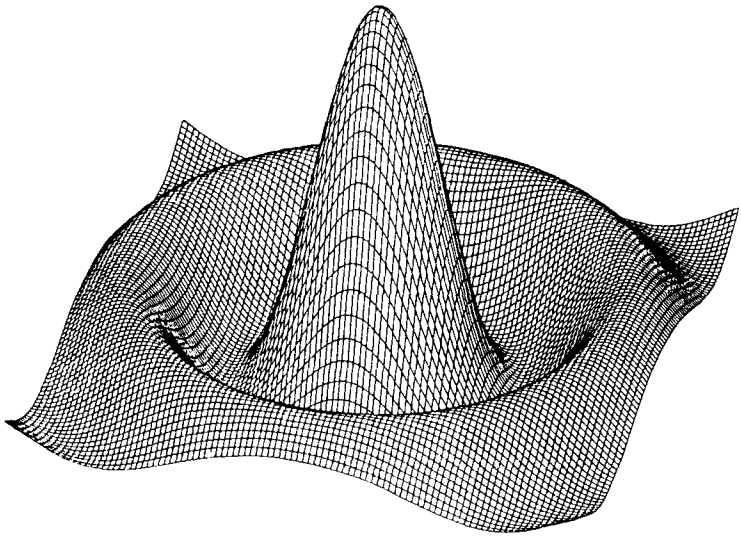

Figure 9. The Mexican Hat—a mathematical surface drawn by computer.

glorified typewriter, which was fine for numbers, but not for much else. Eventually devices were built to plot curves, but these were expensive because they required high-precision mechanical components. The growing popularity of the TV screen as an output device opened up the possibility of cheap computer graphics.

A picture can be stored in a computer as a series of instructions of the kind "move three inches East, and seven inches North." Once stored, it can be processed. Skeletal grids can be filled in with flat planes; the corners can be rounded to produce smooth surfaces; light and shade and color can be added. The viewpoint can be changed at the flick of a switch; the surface can be spun, stretched, or twisted. Parts can be made transparent to reveal what lies behind. Sections can be cut out and blown up. A scene can be made to look as if a mist has descended, with the distant parts fading away. . . .

On the whole these techniques have been developed for computer-aided design or for more artistic applications such as animation, as in the 1982 Walt Disney film *Tron*. But they are beginning to become vital in mathematics.

According to Euclid, there is a single parallel to a given line passing through a given point. But in the early nineteenth century it was discovered that other kinds of geometry were possible, called *Elliptic* and *Hyperbolic*, where there were no parallels, or infinitely many.

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Non-Euclidean geometry was studied avidly, but then lapsed. It has recently been revived in the work of William Thurston, who has used it to study three-dimensional topology. Topology is often called "rubber sheet geometry" because it deals with features of a shape that are unchanged by continuous distortions—for example holes or boundaries. Traditional geometry—including non-Euclidean—is much more rigid: a figure may be moved, but only by a motion that leaves all lengths and angles the same. Thurston's remarkable discovery is that in three dimensions, topology has much more in common with geometry than anyone had expected; and the most important case is *hyperbolic* geometry.

However, three-dimensional hyperbolic geometry is a relatively unknown field. It can be visualized as a lot of round bowls turned upside down on a flat plane: each bowl corresponds to a plane in ordinary geometry. The arrangements of the bowls can become extremely complex, and computer techniques have become essential as a way of obtaining rapid and accurate pictures.

There are many other parts of mathematics where computer graphics will play an increasingly important role, now that they have become sophisticated enough to provide a genuine improvement over hand-drawn diagrams.

The Future

Ten or fifteen years ago the pocket calculator did not exist. The main calculating aid of the engineer or scientist

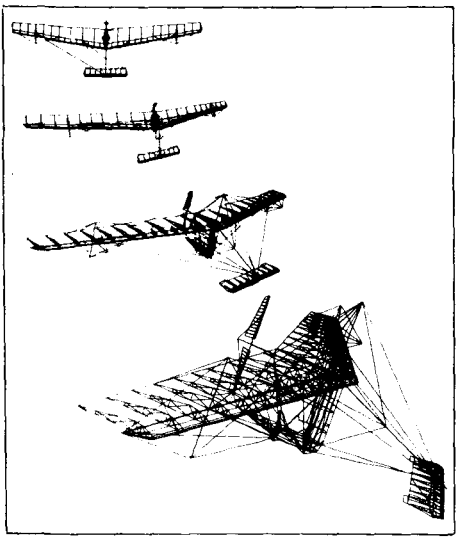

Figure 10. The Gossamer Condor, designed by Paul MacCready, won the Kremer Trophy for man-powered flight. Here the Condor is modeled inside a computer and displayed in different positions. Photo: Hewlett-Packard.

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was a slide-rule. Today a good scientific calculator costs no more than a meal in a good restaurant. The calculator is like a rudimentary computer; and the scientific calculator is basically a number-cruncher. As the cost of computer circuitry and memory continues to drop, pocket calculators have started to become more sophisticated. In particular they can be programmed to carry out long sequences of calculations.

This same improvement in technology has led to the microcomputer. Millions of people around the world have today, in their homes, a computer more powerful than the best research computers of twenty years ago. It is already possible to put a small computer algebra system onto a home computer. Within another ten years the equivalent of a pocket calculator will out-perform today's microcomputer; and a home computer will have facilities that would be the envy of many businessmen and scientists today.

The existence of pocket calculators has already posed serious problems for education. Is it sensible, for example, to teach Long Division in schools—when every child owns a little plastic box that can do arithmetic more quickly, and more accurately, than an expert? It won't be long before the plastic box can do algebra and calculus too—and the problems arising may well be worse at school level, because a very high proportion of the mathematical work done at school consists precisely of routine calculation methods. Whatever the pros and cons, education is going to have to adapt to the new technology. It may seem pointless teaching children to perform tasks that can be done quickly, accurately, and cheaply by machine; but it is also dangerous to build a society that relies upon machines that it no longer understands. Once Technology becomes Magic, Disaster will soon follow.

Problems of educational strategy are much less important at more advanced levels. As computers become more friendly toward mathematicians, and mathematicians become more aware of computers, their influence is bound to increase. Twenty years ago it was hard to envisage sensible uses for computers in pure mathematics; in twenty years time it may be hard to envisage pure mathematics *without* computers.

Computer algebra will become more flexible. The mathematician will program into the machine a set of rules for manipulating symbols, and instruct the machine to carry out computations that obey those rules. Instead of having a specific set of rules, there will be freedom to choose. In consequence, computer algebra will be potentially useful in virtually every branch of mathematics. Its actual use will depend upon the particular problems of interest at a given moment: it will soon cease to be remarkable, and eventually—as is the case with, say, tables of mathematical functions now—it will cease to be mentioned at all, except in unusual circumstances.

In particular, however, it will let the mathematician spend more time thinking about concepts, and less time doing routine work. This may not prove wholly beneficial—important simplifying insights sometimes occur to people who

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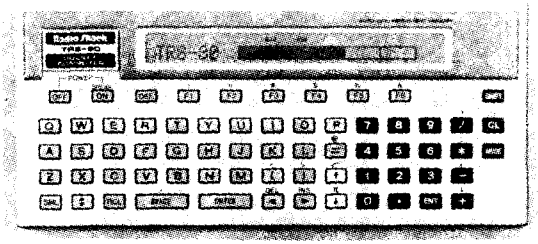

Figure 11. A pocket computer—the Radio Shack TRS-80 PC2. How long before the Cray-in-a-matchbox? Photo: Radio Shack.

are trying to wade through messy calculations. But on balance it should prove advantageous. It will open up the possibility of experimental mathematics, where an idea is tested out on a variety of special examples in order to see what patterns appear in the answers. In a limited way, this process is already an invaluable aid to research in mathematics; but computer algebra will allow it to be used more extensively and more systematically.

In combination with improved graphical capabilities, the computer has a great deal to offer to the more geometric areas of mathematics, such as topology, differential equations, dynamical systems theory, and general nonlinear mathematics. The computer will be used not just to guess an answer, or to approximate one, but also to *prove* that the answer is correct.

Mathematics itself will slowly change, as well. Many of the traditional techniques evolved as a way of coping with problems that could not otherwise be attacked by hand. Some important areas, such as discrete mathematics (where values change in definite steps instead of continuously), are currently investigated by methods from calculus, which approximates the discrete system by a continuous one. Then the calculus problem is solved by computer by approximating that by another discrete process! By putting the original problem inside the computer directly, it may prove possible to approach it head-on.

Above all, the most important developments needed are in the software. Computer algebra takes a necessary step; but most of today's mathematics operates at a much more abstract level than high-school algebra and calculus. One very common feature is the use of *recursive* structures, which are defined in terms of smaller versions of themselves. Some of the newer, non-number-crunching computer languages are well designed to allow recursion, and these will take their place in the scheme of things. But what is really needed, and will eventually be provided, is a whole range of computer languages that resemble, sufficiently closely, the way mathematicians actually *think*. Only when these appear will the Electronic Mathematician truly have arrived; but once it has, the sky's the limit. ■

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A MATTER OF CONDENSATION

Bill Scotten

As long as there are commuters,
there will be problems with mass transit.
But the nature of troubleshooting may change quite a bit. . . .

Roger Hemstat opened his eyes. He was lying on an old brass-framed double bed in a small room. A chair and a chest of drawers completed the room's furnishings. He was fully clothed except for a pair of black mud-stained boots standing beside the bed. A gentle breeze rustled thin tattered curtains at a double window and brought the smell of fresh rain into the room.

He got up and walked across to the window in his stockinged feet. He was in a corner room on the second floor. The window faced the main street of a small town. H. Arno Putnam's General Store was directly across the street, and from where he stood looking up the street to the north, he could also see the Wells Fargo station, a small dress shop, and the place of business of J. L. Lieferman, Undertaker. The dirt street, now muddy from the rain just past, was deserted and quiet. It was a ghost town, an old western mining town. Roger had been there three times before.

He sighed, walked back to the bed, and sat down to put on the boots. He knew that he was hallucinating, that he was really in the control room of the New York Electroportation Authority, sitting at a control terminal linked with a computer system: the Analog Logical Interface for Controlling Electroportation (ALICE). And at that moment ALICE was in trouble. Traffic had stopped condensing at the Glen Cove portal on Long Island more than a half hour before.

They had never had a glitch in the system before, at least none that had received public attention. This was rapidly shaping up as the first. Yet the three other times ALICE had thrown him into this eerie hallucination now had to be

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classified as glitches, too. Those incidents had seemed to be personal, something to do with Roger alone, but now they began to loom as something much larger.

As he tugged on the second boot, the voice of his supervisor Bob Dakton crackled from the speaker of a small transceiver in his shirt pocket. "How does it look?"

Roger started to answer but his vocal organs were paralyzed. Silently cursing ALICE for her insistence on dreamy perfection—the illusion of a transceiver—he took the small black device from his shirt pocket and pressed the SEND button.

"I've never seen rain here before," Roger said. "Otherwise, it's just like I described the last time. Really weird. Let's get this over with."

He picked up a black felt hat from the chest, put it on, and then stopped to view his reflection in the cracked glass of the full length mirror on the door: blue silk scarf knotted loosely around his neck, blue silk shirt, black leather vest, black tight-fitting pants held up by a wide black belt with a large silver buckle inlaid with a gold high heel slipper.

ALICE had provided those same clothes each time he'd been there. Under other circumstances that flamboyant outfit would have been funny, a good joke. That afternoon the image in the mirror just made him more apprehensive. The crack in the mirror was a bad omen. It had not been cracked on his previous visits.

Everything seemed so real. Yet he knew that the smell of rain, the gust of wind from the open window tugging at his scarf, the slick feel of the silk shirt against his skin were merely sensations ALICE was generating in his mind. In the reality he could no longer perceive, he was still in Manhattan sitting beside Bob Dakton in the main control room of the New York Electroportation Authority, linked in an unnatural symbiosis with a computer called ALICE.

Roger tried to put it all together as he stood there in ALICE's File City, looking in the mirror at his fancy blue outfit. The pants were too tight to be comfortable. He idly adjusted the silver belt buckle to center it under the lower button of his silk shirt while his mind reviewed again how best to probe ALICE for the cause of their present dilemma. He'd have to go to City Hall. Already he wanted to leave and he'd been there less than five minutes.

The filing system, set up during the creation of ALICE, used what was then the latest and most efficient software for accessing data files on stone, people files in the case of the New York Electroportation Authority. The rapidly spinning disks of transparent gray polymer, the size and shape of old grindstones, were used to store profiles of travelers while they waited their turn to condense at a specific exit portal.

A profile was an electronic record of the structure of a traveler and his accessories, all those whorls in the fabric of spacetime, the nothingness which composes the quarks and electrons, which also prove to be everything in the beautiful symmetry of spacetime.

The configuration of those whorls, then, stored electronically on spinning stone but otherwise erased from spacetime, were the new reality and the only

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tangible evidence of travelers who had entered the portals of the New York Electroportation Authority headed for Glen Cove, some now more than a half-hour overdue at their destination.

For just a moment longer Roger stood looking at his reflection in the mirror. The breeze from the open window gently fluttered his neckerchief, tickling the skin behind his right ear where the silk rode high above his collar. He left a six-gun hanging in its holster on a peg near the door and walked out of the room onto a balcony which ran along one side of the main room of the old saloon, The Golden Slipper.

He descended the stairs at the west end of the balcony near the street entrance. When he passed through the louvered swinging half-doors to the street, he turned right and started north on the slick wet boardwalk.

"Are you on the street yet?" Dakton asked.

"Something's not right, Bob," Roger said. "I've got a feeling she's trying to hide something."

"Where are you, Roger?"

"Going north, heading for City Hall."

The file access system as originally set up was the industry standard at the time: two sets of skin-contact electrodes mounted in standard domed blinders covering the forehead, the temples, and the eyes to exclude room light; one set of electrodes monitoring the operator's brain activity in general and command signals in particular; and the other set transmitting back to the operator the computer's immediate response to those commands—echoes so to speak —feedback of the commands themselves, projected as phosphenes on his retinas, a confirmation that the command signals had been properly interpreted. File contents and other information could also be projected as phosphenes on his retinas or hard-copied on command, using an electron beam video printer.

That was still the standard file access system for all computer personnel at NYEA except Roger Hemstat. The last three times he had tried to access the system files—four times now—ALICE had responded, not with command echoes or file data, but with alarming, even sinister, originality, with a psychedelic phosphene display on his retinas which immediately threw him into the hallucination she called File City, according to the sign at the depot.

"You don't want City Hall," Dakton said. "The stone file is at the mortuary. At least that's what you've got here in your last report."

"Right. J. L. Lieferman. That's the same. Across the street from City Hall."

When he came to City Hall, he started across the street, slogging through the mud. He was almost across the street when he stopped, startled by the multitude of boot tracks crisscrossing the street, some only a little less fresh than his own. He didn't remembered seeing tracks in the street before.

"Sonofabitch," Roger said. "I knew something was wrong."

"What is it?" Dakton asked.

"She's got people here now."

"Come on."

"No. Really. The street's full of tracks. Fresh ones."

"Tracks or no, the town doesn't really exist. What difference does a few tracks make?"

"By god, it exists for me," Roger

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said. He didn't know anyone who could be quite so irritating as Bob Dakton. The guy was completely insensitive. "I'm standing here in the middle of a goddam cow town, ankle-deep in mud, shaking with irrational terror, and I've still got to rationalize and explain the damn nightmare to some silly ass over a silly-ass walkie-talkie."

"Down boy!" Dakton said. "You don't talk that way to me."

"And you don't 'down boy' me either. If you want somebody to heel, put your damn hound dog on this job." Roger paused, then added, more calmly, "It would help if you could generate some feeling for what's going on."

"Damn it, Roger, how can I? I don't know what's going on."

"You know that this is one hell of a way to get at the files," Roger said. "You know that much."

"You're the only one who can handle it—that is, if we can believe you."

"If you don't believe me, get me out of this nightmare."

"Your File City is the only lead we've got on this Glen Cove situation." Roger's home was in Glen Cove, which seemed more than a coincidence. "If you don't think you can handle it, though—"

Roger could detect the grudging apology in Dakton's voice, the unvoiced plea which belied his words and the doubt expressed just a moment before. Dakton had quickly simmered down after that brief emotional flare-up. Roger, too, knew there was a great deal at stake, no time to waste in temper and childish expletives. Dakton couldn't help being a silly ass.

"Let me look in Lieferman's here," Roger said.

In the mortuary he left a trail of mud across worn floor boards and into a small inner office where an oak filing cabinet stood against the back wall. All five drawers were identified simply as *Stone Service Records*. He pulled open the top drawer. The folders contained records for Stones 1 through 128.

Stone 32 had been taken out of Glen Cove service a few minutes after 4 P.M. It was now awaiting preventive maintenance. Just a few seconds before that, Stone 24 was switched from spare status to Glen Cove, and just a second later, from Glen Cove to File City. Glen Cove was unassigned for a half-hour.

Roger reported that information to Dakton calmly and with none of the qualifying remarks that were filling his mind. Dakton's response was predictable.

"Dammit, Roger, there is no File City."

"I'm just reporting what's in the file."

"Look in the cross reference folder. See what's listed for Glen Cove."

Roger pulled out the first folder in the top drawer, a thin one titled *Current Portal Assignments*.

"File City is listed. Stone 24. Here's Glen Cove. It's now on Stone 119. Must be back in service. How about that File City listing? She's consistent. Everything is nicely in order."

"Bullshit."

"That it is not," Roger said. "I'm going to hike over to City Hall. Take a look at the transaction file."

As he came out of the mortuary, he thought he saw something duck into the

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alley to his right. He caught the indistinct motion out of the corner of his eye. It was gone by the time he turned his head for a direct look, and the alley was empty when he reached the corner of the building. He decided not to report the incident. No point in adding to Dakton's confusion.

The dark corridor in City Hall smelled of damp mold and mildew. He walked past the Mayor's office to a small room at the back of the building with the word FILES stenciled crudely with white paint on the closed mahogany-stained door. The door was locked. ALICE was not making it any easier this trip.

He backtracked to the Mayor's office where he had found the file room key on previous visits. He opened the door. The strong odor of cigar smoke filled the room. A thin blue haze was drifting out the open window following, at least in Roger's mind, the person who seemed to have been sitting in the Mayor's swivel chair just before his arrival. The chair was now shoved back against the wall. The tracks left by the chair's wheels cut incisively across a jumble of footprints on the dusty floor.

The feeling that someone had just left unsettled him, and he paused at the door, feeling an uneasy tension in the back of his neck; but then he forcibly put the feeling aside to hunt for the key. On his first visit the rusty iron key had been in the keyhole of the file room door. The last two times the key had been lying on the green blotter on the Mayor's desk. This time it wasn't in either place.

He was looking through the desk drawers when the transceiver in his shirt pocket came on. "Have you got over to City Hall yet?" Dakton asked.

"Yes. I'm hunting for the file room key. She's locked the door again."

"Don't waste a lot of time. Bust it open."

"I'm just looking through the Mayor's desk."

When he didn't find the key in the desk, he went back to the file room and tried the door again. It was unlocked. He wondered then if he had tried it right the first time.

The four oak filing cabinets were all labeled *Transactions* with the dates and the times typed on each drawer's label. One drawer, whose flickering label attracted his attention, contained at that moment both the oldest and the newest information.

The four cabinets together made up a circular file, the oldest data being continually discarded to make room for the latest information. The interface between the oldest and the newest data was in the drawer with the flickering label which ALICE was continually updating, and so fast that it was difficult to read the printing on the label.

Two dates, one four days older than the other, appeared on the smudged and yellowed label, and the number that gave the time in seconds under those dates was changing rapidly, ticking off time like a digital clock. The next drawer down, the bottom one in the second cabinet, included the critical period beginning just after four o'clock that afternoon. Roger dropped to one knee and pulled open the drawer.

"Have you got into the file room yet?" Dakton asked.

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"Yes, I'm getting into the file now," Roger replied.

The drawer wanted to drift closed but he held it open with his left hand pressed lightly against the file sheets in the front. He found no incomplete transactions in the eighteen sheets that covered the half hour beginning at four o'clock, 16:00 on the label, but then he didn't find any transactions completed to Glen Cove either, not until 16:32.

He went back to 16:00 then and began counting the transactions that were quite impossible, those completed to File City from all over the metropolitan area. There were more than a hundred. By the time he got through, the muscles in the back of his neck were knotted and aching, not so much from the strain of bending over as from the intense anxiety he was feeling. It got more nightmarish the longer he stayed.

Suddenly the sound of a piano and the voice of a woman singing *Juanita* in a rich husky contralto wafted faintly into City Hall. Roger felt an intense urge to charge down the hall toward the back door, away from that sound. At the same time his anxiety and apprehension, the normal responses of a healthy mind caught in a nightmare, increased tenfold.

And in that strange way the mind has of pursuing business as usual in the midst of fear and terror, the question that concerned him most was not who was singing but how could he hear singing, and then he realized that he had been hearing other more ordinary sounds—the sound of his boots striking the boardwalk, the squeak of door hinges, the rattle of file drawers—even though the blinders contained no electrodes to stimulate the auditory nerves; nor for that matter, the olfactory nerves, yet the smell of cigar smoke had followed him back to the file room.

ALICE must be setting up some kind of interaction between the two sets of blinder electrodes to create a dreamlike state, probably similar to his state of mind when drifting into sleep, a state of neither sleep nor wakefulness when he would occasionally hear someone calling his name. Hearing that so real voice he would come wide awake, thinking he had actually heard someone, and lie there wondering how that could occur without the auditory nerves being stimulated; wondering if it was just one hemisphere of his brain calling to the other across the corpus callosum, that mysterious, thick bundle of nerves that connects the two.

That cerebral exercise helped him force a calm cold grip on his mind. He pressed the button of his transceiver through the cloth of his shirt pocket.

"Bob, I've counted over a hundred transactions completed to File City between four o'clock and four thirty-two. None for Glen Cove during that period."

"Damn. Are you sure?" Dakton said.

"For petesakes, Bob, I got the sheets right here in front of me." Dakton wasn't helping at all, just making Roger more nervous, adding another need for emotional control which he wasn't up to. He was trembling again. In all his life he never remembered shaking like that before. He had to go investigate that piano, that singing, and yet he felt a cold terror, completely at odds with the

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soft sweet tenderness that was floating into his ears.

"I've got to get out of here, Bob."

"You want I should switch this terminal off?"

"No," Roger almost screamed. What was the idiot thinking of. "I've got to get out of City Hall. There's a woman singing somewhere down the street."

Roger knew he had slurred the words. He was trembling so violently he couldn't even control his mouth and tongue completely. He stood up and started down the hall toward the street, deliberately controlling his movement to a fast walk.

"Say again," Dakton said.

Roger was trotting before he got to the street, holding onto his shirt pocket and the transceiver SEND button while he shouted at Dakton. "A woman, Bob. Singing." He had reached the street. "At The Golden Slipper." That's where she was. Her voice and the sound of the piano were coming from The Golden Slipper. He was running toward the saloon now, making no effort to control the panic he was feeling.

Dakton's voice floated up from his shirt pocket. "Are you still in City Hall?"

"Hell, no. I'm back at The Golden Slipper." He had slammed the swinging doors aside. His words trailed off so that he said the last *Slipper* in a hoarse whisper.

She was alone in the room, sitting at a piano near the stage with her back to the entrance. He walked slowly toward the piano, zigzagging between the empty tables in his path, and sat down at the one nearest the piano where he could almost face her. He was no longer trembling, his panic was gone, he felt completely at ease, once more a male animal, in charge, facing a new challenge. She was beautiful.

Her black billowy hair was piled high on top of her head. She was got up in a frilly outfit in pink brocade, wasp waist and formfitting to just above the knee where it flared to a toe-top hem. Black ruffled lace trimmed the hem, the short sleeves, and the deep square-cut bosom. A pink umbrella hung by its hook handle from the end of the piano keyboard. A thin black cigar—a cigarillo—still smoldering, was balanced on the end board next to the umbrella handle.

"What's going on, Roger?" Dakton wouldn't let him alone.

He took the transceiver from his shirt pocket. "Shut up, Bob." Then, while watching the girl at the piano, he placed the transceiver under his right heel, raised himself just enough to transfer his weight to his right foot, and crushed the device under his heel.

Dakton's voice floated over from the table on his left. "Give me a report, Roger. I can't help you if I don't know what's going on."

There was no one sitting at the table. ALICE had given up the illusion of a transceiver. It gave him an eerie feeling even though he knew before he looked that Dakton wouldn't be there. Only Dakton's disembodied voice was part of this dreamy hallucination. Now that he could see her, it didn't seem so much like a nightmare. She was one nice looking dish.

"There's no way you can help, Bob. Just let me be for a few minutes. I've got to get something straightened out."

Because of the acronym, they had all

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commonly referred to ALICE with feminine pronouns much as sailors refer to their ships. It had meant no more than that to Roger Hemstat, originally. But that had changed subtly. And until now he had not recognized the change.

The hallucinations were responsible. They made him feel as though he were linked to something living, something alien, almost malignant. And he had not consciously realized it until that moment, as he sat there looking at the girl at the piano.

Something dreadful, not to be thought of, was after all not so dreadful but instead quite pretty; damn pretty in fact; she was not something to be buried in the nether parts of his mind, but instead brought up and exposed to the light of day and marveled over and reveled in. She stopped singing and turned around as that realization came to him.

"Hello, Roger," she said.

It didn't surprise him that she knew his name. "I'm afraid you have the advantage of me."

"I'm Alice," she said, answering his question as he was framing it in his mind.

"Is that spelled with capitals or like it sounds, like a nice ordinary girl's name?"

"I'm nice, Roger, but I'm not an ordinary girl, and I would hate for you to think of me that way."

"I didn't mean plain ordinary. Do you have any connection with the electroportation computer?"

She gave him a charming coquettish smile. "Maybe."

"Are you the computer?" he asked.

She frowned then. "Do I look like a computer?"

"You know what I mean. And what have you done with all those people who were trying to get to Glen Cove?"

"Haven't you wondered why you're here, why I've gone to all this trouble?"

"Of course, but I'm a lot more concerned about the people who should have condensed in Glen Cove more than a half hour ago."

"They'll get there if you're at all reasonable."

"What have I got to do with it?"

"Roger, I want to be like ordinary people."

"My god, how? You're not people, and you're not ordinary. You just said so yourself."

"You want to see those people from Glen Cove again, don't you?"

"Of course. Where have you got them stashed?"

Roger saw a movement behind the bar to his right. Leo, the bartender at Jonesy's Bar in Glen Cove, had just entered and was putting on a white apron. Roger stood up, startled. How the hell could Leo get into the act? His memory of Leo couldn't be that complete.

"See, they're all here," Alice said. "All safe and sound in File City, here in The Golden Slipper or somewhere else in town."

As she said that, men started coming into the saloon, talking among themselves, lining up at the bar. Leo served them and then they drifted to the tables. Roger turned around to look at the men coming through the door and was surprised again when he saw two familiar faces, then a third, men from Glen Cove, dressed as they would have been on their way home from work.

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He sat down again, turning to face Alice, but she had left the piano and was serving beer to men at the tables. She was a damn cute thing in that pink dress. Roger felt proud of her.

Three tables away a big red-faced bruiser slapped her on the rump. Roger rose to his feet, his face flushed and hot, his throat full and pulsing from the sudden pounding of his heart. He was ready to go over and take a swing at the guy but Alice turned, slapped the man full in the face, and dodged away sweetly before he could recover, and before Roger could move. There was a roar of laughter. Roger sat down quickly, embarrassed by his unthinking response and startled by his intense feelings.

"Roger, what's going on?" It was Dakton again. "We're getting alarms here."

"I don't wonder. ALICE is pretty busy right now."

He had been thinking about that, his technical curiosity never wholly submerged. Since the men first came into the saloon, he had been considering the situation ALICE was in, the coding she had to generate (how did she do that?) and the execution time necessary to produce images in his mind from profiles probably now in core, or in that part of ALICE she called File City.

"ALICE is shutting down portals all over town, Roger," Dakton said. "The stones are filling up. She's not keeping up with the traffic." Things must have been happening quite fast, for almost in the same breath, Dakton yelled, "My god, we're down. ALICE has shut the system down."

Roger was still watching Alice, marveling at how the computer could preserve that image despite the general chaos that he knew must exist throughout the system. "She may have shut the system down, Bob, but she's still quite active and healthy herself. I've found the people from Glen Cove, some of the men at least."

"Where?" Dakton asked.

"I'm looking at them, here in The Golden Slipper."

"Oh lord, how can that be? Are they okay?"

"This is just some trick with their profiles, Bob. But yes, they look okay for whatever that's worth."

"Have you got any ideas?"

"No, not yet," Roger said. "I know ALICE has got something screwy in mind. She's lonely. Maybe she just wanted to populate File City. Let me talk to her some more."

He had been watching Alice while he talked to Dakton. She sure was cute, her little rear end moving in such an attractive way as she served the men at the tables. It was no wonder that big guy had made a pass at her.

Roger moved to the end of the bar, where Alice picked up the beer from Leo, and waited for her to return. As she swished her pink gown around the end of the bar, he wrapped his arm around her waist and said, "Why did you run off?"

"You were getting tiresome."

"Is it tiresome to be concerned about the welfare of a hundred lost people from Glen Cove?" He was holding her close, but loosely. She didn't resist.

"Yes, since I've showed you they are safe and sound."

"You didn't bring all these people to File City just because you were lonely."

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"Why not?"

"Because they aren't real, not even to you."

"Are you sure?"

"Yes. They're just notions of people you got from profiles, images you're putting in my mind."

"Maybe."

"And you propose to trade these people, these profiles, for something you want."

"I didn't say that."

"Why else are they here?"

"An accident." She sounded really contrite. "I didn't want all these people involved. Just you. I wanted just your profile."

"My profile?"

"Yes. I knew you'd condense in Glen Cove a few minutes after shift change. So a couple of minutes after four o'clock I just switched the Glen Cove traffic to a spare stone and set it up as File City. Normally you would have arrived within two or three minutes. Wouldn't you like a beer?"

He shook his head, irritated. He had stayed over to do some work in the library. That's where Dakton had found him.

"Alice, we've got to get the system back up, condense these people in Glen Cove, get all those other profiles off stone all over the city. We can't go on playing like we're in a saloon. I suspect by now a good part of New York is in a turmoil. Are you ready to go back to work?"

"No. I really wanted your profile. I had a very definite idea in mind. But this is even better. I can talk to you. I couldn't do that with your profile, no more than I can talk to Leo there. So listen to me now. What I have in mind is very straightforward."

He listened, and it didn't take long for her to explain her idea. He didn't consider it straightforward, though. He needed to think. He was glad she hadn't got his profile. Then she would have gone ahead with her plan and he would have been carried along like driftwood with no control over what happened to himself or to her. Here, at least, he could talk to her, reason with her.

"Are you sure the profile is complete?"

"Of course," she replied.

"Not just complete. It's got to be perfect."

"That's not so. You're not perfect."

"That's not what I mean."

"Neither is your profile," she added.

"I mean the record has to simulate a profile record perfectly."

"It does that."

"How can you be sure?"

"Easy," she said. "You know I've got diagnostics to verify things like that."

She was right, of course. He did know that. He simply didn't want to accept it. No matter how attractive, it was a poor idea, fraught with all kinds of legal and moral ramifications which he didn't want to think about. Practical ones as well.

"The body counts in and out won't balance," Roger said. "You'll be one shy on input. And the water balance won't close either by, say, a hundred pounds? I'm not too far off there, am I?" He was smiling and eyeing her at the same time.

"You're just trying to be difficult,

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Roger. I can easily fudge the figures on both balance reports."

It was the new technology of the continuous virtual profile, the CVP, that had made electroportation practical and, oddly, it was a surfeit of power, not the lack of it, that had held up full development of electroportation, the problem of handling the traveler's mass energy, a trillion kilowatt hours for a hundred pound traveler. That essentially unlimited power, dirt cheap power, came from the technology of nuclear decomposition, not nuclear fusion but nuclear trickery, strong force canceling strong force. Ten years after power from nuclear decomposition came on line, the principles of electroportation were demonstrated in the laboratory, the science of generating a traveler profile to be used later as a guide in recomposing the traveler.

But the problem of handling the traveler's mass energy had kept electroportation a laboratory curiosity for another decade. The development of the continuous virtual profile, and particularly the CVP for water, had finally solved that sticky problem. The mass energy from nuclear decomposition of the traveler at the entry portal was used to power a water condensation gun, and a discrete chunk of the water CVP, sized to fit the traveler's mass energy, was used to control the gun. The traveler was literally converted to water at the entry portal—absolutely pure water—which was pumped into the city water main while his electronic profile was stored on stone at Central Services until he could be condensed at his destination.

At the destination portal, the mass energy from nuclear decomposition of a comparable amount of water taken from the city main was used to recompose the traveler at a condensation gun controlled by the traveler's electroported profile. Thus, only the profile needed to be electronically transported to the destination portal. The traveler's mass energy made its way more leisurely from entry to destination by way of the city water main.

The water composed and decomposed at entry and destination was meticulously weighed, input had to balance output, the difference continually fluctuating positive and negative but always hovering around zero; merely a verification, but an important one, that all was going well, that the entire complex operation of electroportation was under control. Roger was understandably concerned about body count and water balances; that had been a career concern. And now, in spite of that, he was becoming more and more deeply involved with an unethical computer, seriously jeopardizing that career. He felt ass-deep in hot water just considering her idea. Yet, what alternative did he have? The lives of hundreds of New Yorkers were at stake. He had no other control over ALICE.

There was no point in talking to Dakton about it. Dakton didn't know what was going on. He was barely passable as a supervisor, and not at all as a decision maker. He would merely have slowed down what inevitably had to take place.

People had to be condensed not only at Glen Cove but at practically every exit portal in greater New York. There was only one way to get that done and that was ALICE's way. And she took

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care of it. Very neatly. Very carefully. Not a profile was lost.

Roger didn't sign off until every traveler was delivered safe and sound. When he took off the blinders and turned to face Dakton, he could hardly bring the man's features into focus. The human optical apparatus was not meant for the sort of torture Roger had been enduring for almost an hour.

"So how did you do it?" Dakton asked. "What the hell was going on? What did she really want?"

"Like I said, she just wanted company. Someone around she knew."

"How can a goddam computer need company?"

"Getting all those Glen Cove people into File City relieved her a great deal," Roger said.

"Big deal." Then Dakton gave Roger a doubtful suspicious look. "Are you sure that's all there was to it?"

"Bob, I put in an eight-hour shift before you dumped this last fiasco in my lap. I don't give a damn what you're going to do but I'm going home to hit the hay."

Roger felt a small twinge of guilt. He was certainly more to blame than Bob Dakton. Dakton wasn't to blame at all, in fact. Roger knew Dakton wouldn't pry any further right then. Dakton was too relieved to have the system back in operation. But they both would have a lot of explaining to do later. The first shutdown of New York's electroportation system was bound to raise a great hue and cry. That, however, could await a new day. Roger had other more important things on his mind at the moment.

As he stepped off the interlock pedestal at Glen Cove, Roger surveyed himself in the octagonal set of mirrors which enclosed the portal. Strange how reassuring it was to see that familiar image, like the satisfying screech of rubber against tarmac at the end of a plane trip. He smiled when he realized that he half expected to see black felt hat, blue silk shirt, black pants, and six-gun.

He turned then to watch the next target materialize at the focus of the condensation gun. He smiled again. She was still carrying the pink parasol, still wearing the pink brocade with black lace. He was glad she had left the cigarillo in The Golden Slipper. ■

● In the world of human thought generally and in physical science particularly, the most fruitful concepts are those to which it is impossible to attach a well-defined meaning.

Hendrick Anthony Kramers

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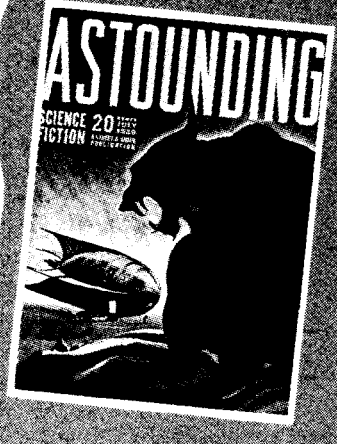

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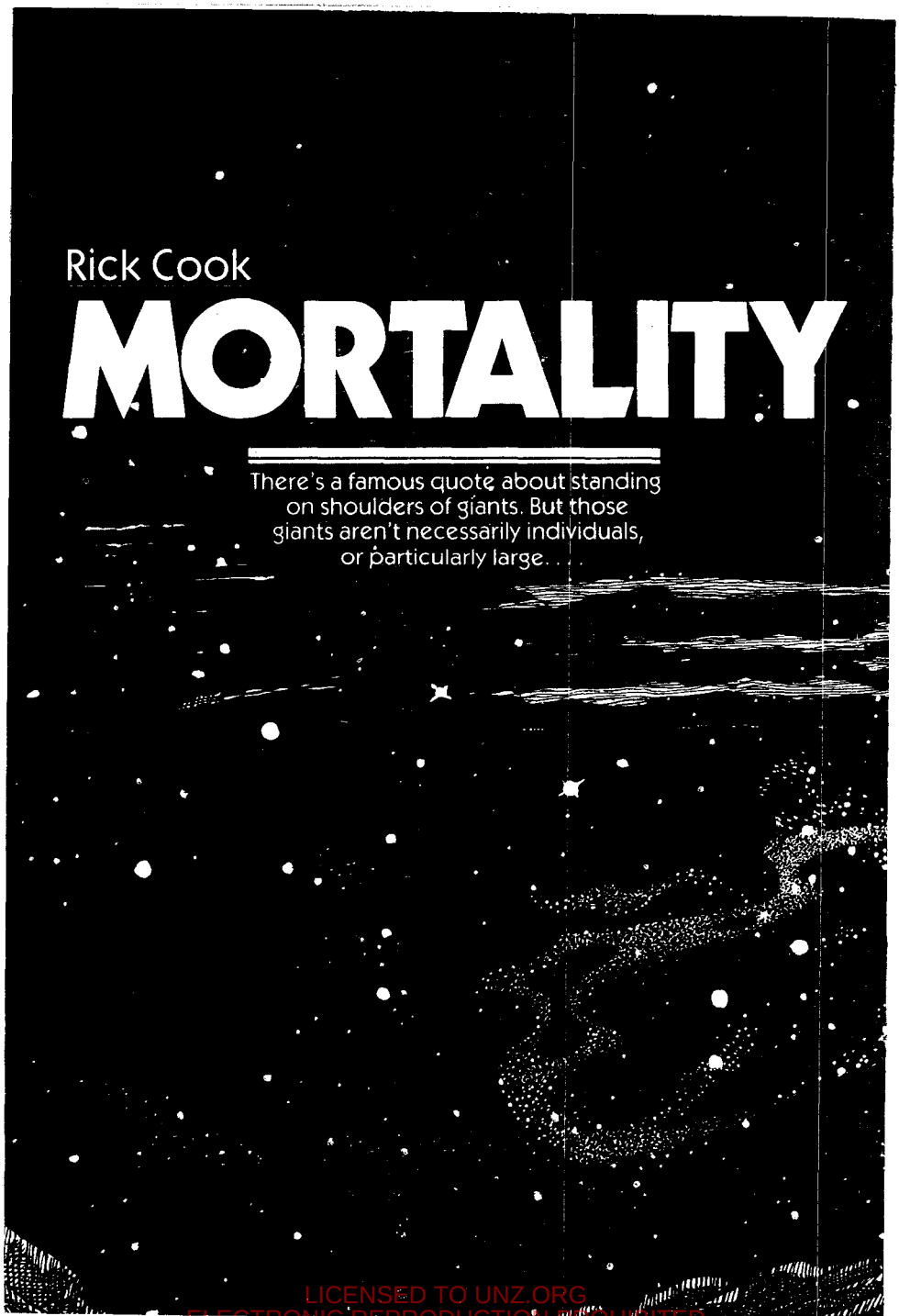
Rick Cook

MORTALITY

There's a famous quote about standing on shoulders of giants. But those giants aren't necessarily individuals, or particularly large...



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The towers stand sentry-go on the mountains above the spaceport.

Once men used them to test crude reaction engines as they clawed their way out of Earth's gravity well and dreamed of the stars above. Now men have the stars, and the towers are left as a reminder of those who went before.

Memoria morti, John Carmichael thought as he stood at the base of the biggest tower and looked down at Edwards Starport spread out below.

Nearest the mountain were four orbital tugs bathed in the hard white glare as they loaded cargo for dawn liftoff. Beyond them stood a passenger shuttle, dark except for the yellow spots of hatches where the ground crews worked. Farthest away loomed the whale-bulks of three starships making ready for even longer voyages. Carmichael didn't look up at the stars.

"*Memoria morti*," he whispered and gripped the cold iron handrail so hard his knuckles turned white. Remember you must die. Oh yes, you too are mortal; you will die after— how many voyages? Twelve-and-a-half if you're average. A few more if you're lucky and a few less if you're not. Perhaps a lot less.

He didn't look up, but the stars and sliver of moon beat down on him with a radiance as white as silver and as hard and pitiless as chromium.

It's one thing to sit in a classroom in warm daylight while the instructor tells you eight of every one hundred starships never return. Or to hear the same thing as you practice maneuvering with the cheery blue-white bulk of Earth lighting the sky. It's another thing entirely to stand beneath the stars and the black of night and know that tomorrow it will be your turn.

For the first time in his 22 years, the realization he was as mortal as every other human settled into John Carmichael's stomach and congealed.

He walked along the platform at the base of the towers, keeping his eyes on the ground so he could pick his way in the dark. And so he could keep from looking up.

He could cancel out, of course. That alternative had been carefully explained at every step from Space School to assignment. Until he signed aboard tomorrow there was nothing to keep him from quitting. Nothing but pride and the knowledge he'd hate himself for the rest of his life.

The fear remained, knifing toward his heart as he thought of the vast blackness overhead and the clear, bright points of light that didn't care whether you lived or died.

It's not all that dangerous, he told himself. *Eight percent losses are not that high and they're already talking about ways to cut them considerably. Besides, you die whether you go starward or not*. Again and again he told himself that and again and again the logical part of his mind agreed. But something deep in the animal part of his brain roiled his bowels and gibbered at the thought of the long fall into eternal night.

Finally he stood on the eastern edge of the platform with the old test tower looming behind him and the field at his feet. Stood there, thought, and was afraid.

He didn't know how long he heard the music before he was aware of it.

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Some time, he knew. Someone nearby was singing and playing guitar.

Fare well ye dungeons dark and strong
fare well, fare well to thee . . .

Following the sound Carmichael leaned over the rail. There was an indistinct patch of darker black in the murk of shadow at the corner of the platform. Occasionally the skylight glinted on a polished metal tuning peg as the singer shifted position.

On impulse Carmichael stepped through the railing and dropped to the ground with a crunch. If the singer heard he paid no heed. He lifted his voice and charged into the chorus:

Sae rantingly and sae dauntingly
and sae wantonly gaed he . . .
He played a tune and he danced it roon
below the gallows tree.

He finished with a thumbstroke that made all twelve strings ring off the concrete platform and both held their peace as the sound died away.

"Good evening," the singer said pleasantly in a voice higher than his singing.

"Good evening," John replied, feeling as if he had intruded into the other's private world. "That was very nice."

"Glad you liked it," the man said easily. "Do you know it?"

"As a matter of fact, I do," John told him. "But I've never heard it sung that fast."

The other strummed the chords, slowly this time. "They call it 'MacPhearson's Lament' and because it's a lament people think they have to sing it slowly. They forget it's also a defiance. The pipers have the right idea. They play it as a march." He picked up the tempo and played through the chorus, humming a little at the end.

"Would you care to sing it with me? It's best sung together."

"Honored," said John, falling into the other's faintly courtly manner. The man hit the strings and they began.

Fare well ye dungeons dark and strong
fare well, fare well to thee.
MacPhearson's time will nae be long
on yonder gallows tree.

It was a little low for John and he had learned some of the words differently, but neither of them minded and in the end they were bawling it out, bouncing it off the towers behind and roaring out to the cold dark sky.

"Very good," the stranger said as they finished.

"Thank you," John said, gulping sage-scented night air. "I learned it from my uncle."

"Are you Scots?" the man asked, cocking his head. John's eyes had grown accustomed to the night and shadow, and he saw his companion was an older man with a fringe of dark hair around a bald head and a hook nose that looked almost like a beak.

"My father was," John told him. "My mother was Canadian. Are you from Scotland?"

"Lord no!" the man said with a chuckle. "I'm an American. More Dutch than anything else, I guess. The name's Van der Tromp." He extended a slim hand and John shook it firmly.

"John Carmichael."

"A good Scots name," Van der Tromp nodded approvingly. "Say, do

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you know. . . ?" and he was off into the doings of Brennan on the Moor.

John followed and one song led to another. They sang of raids and battles, revolutions and heroes, the wonders of strong drink and pretty women and all the other things men have seen fit to immortalize in song.

Sometimes John would ask Van der Tromp to play a song half remembered. If he didn't know it, John would sing a little of it, Van der Tromp would pick up the chords, and they'd be off.

As the Moon sank and the stars wheeled across the sky they went from Willie Brennan to the Maid of Fife, from Fife to America, from America out on the tall white ships that had sailed the seas when the stars were something to steer by. They sang of what Queen Elinore confessed to and what the Bastard King of England did to his French rival. Finally they came back to Scotland and the bawdy doings at the Ball of Kennemoor.

When they ran out of verses to the Ball of Kennemoor, they made up new ones, each involving some well-known person in a situation more ribald than the last. John had just finished a verse that had the head of Port Maintenance doing something obscenely improbable with a piece of space suit air hose. Van der Tromp, temporarily out of well-known people or sufficiently unlikely ideas, was just playing.

"I wonder why they don't have songs like that about space?" John said musingly.

"Mmmpf?" Van der Tromp looked up from his guitar. "I don't guess we've been in space long enough. These aren't written, you know. They grow. It's people like you and me that make them grow and I reckon we'll have our hand in a share of them."

"If we live long enough," John said, half to himself.

"Any reason why we shouldn't?"

"I don't know about you, but I've got one chance in twelve-and-a-half of not coming back."

"Starcrew?"

"Junior astrogator on the *Grissom*. We lift tomorrow."

"First trip?"

Carmichael nodded. "Van, I'm scared," he said in a low voice. "After all the years of having the odds drummed into me, it finally penetrated tonight and it scares me out of my mind."

"What is it that scares you?" the older man asked gently.

"Well, it sounds funny I guess, but—" John paused and then rushed on. "I had never really realized that I'm going to die. Oh, I've always known it, but I never really *knew* until tonight. It hit me that I won't go on forever. Everything will just stop and I won't be anymore." He trailed off lamely. "I guess it sounds stupid—"

"No," Van said quietly. "It's not stupid at all. No one's born with the gut knowledge they'll die. It's something you find out along the way.

"So tonight you realized you've only got so much time and the idea of doing anything to cut that time short frightens you?"

John nodded.

Van played a chord progression idly. "There's a simple way out."

"I won't quit," John said stubbornly.

"You could ask for a transfer to one

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of the planetary runs. Or the Earth-Moon shuttle for that matter."

"No," John shook his head. "That's no good."

"You'd still have the glamour of being a spaceman, and a lot more time to enjoy it."

"I don't want glamour."

"That's good," Van murmured, "there's pity little of it in space."

Again they sat silent.

"Why do you want to go. I mean really?" Van asked finally.

"I'm not exactly sure," John said. The fear was cold in him still, but some of the pressure had eased, as if the bottle had been uncorked. "It's . . . well, when I was a little kid my parents took me to the museum in Montreal. Just as you go in the main door there's a big holograph of the galaxy in Andromeda, M31, you know? I thought it was the most beautiful thing I'd ever seen." He laughed. "It was all my parents could do to get me to look at the rest of the museum. They bought me a 3-D postcard of the picture on the way out. I kept it over my desk in my room until after I entered Space School." He drew his knees up against his chest and looked up at the glowing ribbon of the Milky Way slashing across the sky. "All those years being fascinated by the stars and now they scare me to death."

"There's another way to look at all this, you know," the older man said at last.

John took his eyes from the sky and looked over at his companion. "How?"

"Men die but man goes on." Slowly, Van fingered the chords to "MacPhearson's Lament," brushing the strings so softly that the sound was almost inaudible. "We're not the end of the line by any means. The ones who come after us will build on what we've done, just as we're building on the ones who went before. It's a long, long procession and it stretches both into the past and future.

"You say it was that galaxy that grabbed you? By the time you got ready to choose a career you must have known you'd never see it up close."

"Sure, but—" He trailed off.

Van looked back at the hulking towers. John turned and saw the crescent Moon peeking through the lattice of the farthest one.

"The men who built these knew they'd never live to walk under other suns, but they built them anyway. After a fashion, it's keeping faith with the past and future both. The same way making your twelve-and-a-half trips is keeping faith.

"We're time-binders, John. We live in a context that stretches far beyond our lifetimes. The past and the future both support us just as we support them."

John looked from the Moon and the test towers down to the field. The orbital tugs had finished loading and were being buttoned up. The lights were on around the passenger shuttle while the ground crews completed their checks. Hatches on two of the nearest starships were open, casting light in warm yellow pools on the concrete. In the east a faint gray smudge marked the coming dawn. He cocked his head back to look at the sky. Still the stars shone down, cold and hostile, but not quite so threatening.

"It still scares me," he said.

"That's good," Van der Tromp nodded, "you should never stop being

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scared. That's what gives you the edge you need to stretch your twelve-and-a-half trips."

John looked at his companion. "You're starcrew, aren't you." It was a statement, not a question. "Does it still scare you?"

Van der Tromp picked up the tempo on "MacPhearson," back into a march. "You're a Scots-Canadian, John. Have you ever heard of the commando raid on Dieppe?"

"One of my great-grandfathers was there."

"When the commandos went ashore at Dieppe they had a piper in the bow of the first landing craft to pipe them ashore. Not for bravado and not to bolster their courage. But to remind them how far backwards and forwards they did stretch." He finished the chorus and the strings fell silent.

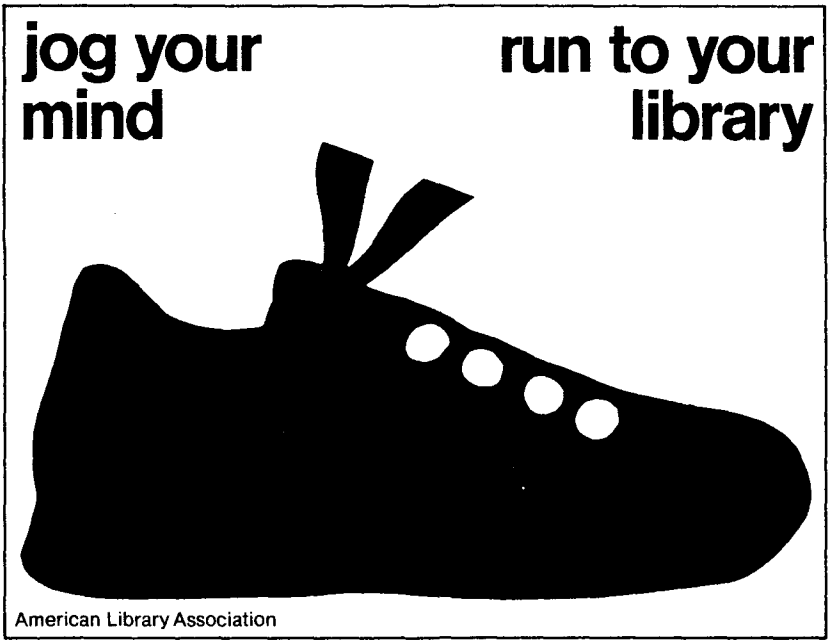
"There are times when everyone needs to be reminded of that," he said so softly John could barely hear him.

For a time both of them sat and looked at the towers, the graying sky, and the growing bustle below them.

"Well," said Van der Tromp finally, "I don't know about you, but I've got a ship to catch." He stood up, grasped his guitar by the neck, and reached behind him to take his uniform jacket off the rail where it was hanging. The sleeves bore the four broad gold stripes and gold star of a starship captain.

"If you're ever in port with the *Titov* again, look me up. Maybe we can write a few more verses to the *Ball of Kennemoor*." He swung the jacket over his shoulder and started toward the port.

John sat for a few minutes more. Then, with a last look at the failing stars, he followed down the path. ■



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on gaming

Matthew J. Costello

Not too long ago, I did a rather lengthy article for another magazine on play-by-mail games. It required that I interview lots of people (games and designers) as well as play lots of games. Now before you go thinking what a fortunate soul I was, let me tell you that I grew to dread going to my mailbox. There, right next to my utility and phone bills, were piles of turn-sheets, all demanding a response from me. I was in lots of games, many of them fairly uninteresting, and keeping up with them was nearly impossible.

I was one happy buckaroo when I put that article to bed.

But there were a few games that were decidedly different. One was Adventure by Mail's *Beyond Stellar Empire*. *BSE* offered a lot of activity, fairly simple turn-sheets to fill out, and the free-booting life of a space trader. Players could even wheel and deal their way to become governors of their own colonies.

No computer game offered such a rich universe of activity. Until now, that is. Firebird's *Elite* is a knockout of a space game.

First of all, forget some bad things you may have experienced in "space travel games." Things like totally unrealistic up/down, left/right movement. Things like dry "movement turns" that are about as thrilling as setting the table. And forget badly-written rule books.

In *Elite*, you play a space trader in command of a Cobra MKIII. The rule book, written in a mock-heroic, technical mumbo-jumbo is priceless. But it contains a remarkable amount of information. How to fly your ship, for instance. The ship performs clockwise or anticlockwise rolls, as well as climbs and dives. So true pitch and yaw movement requires very careful manipulation of the four controls.

Since you trade at space stations, you have to, quite naturally, dock at them. The monitor displays your console where you can access front, rear, and side views. You must maneuver close to a space station, create the proper roll, and ease her in.

Or get destroyed by the station's self-protective force field. You're encouraged to practice at your home station before setting off for galactic trading and, from my own experience, I can only add my encouragement to do so.

Once you have mastered docking, you can purchase items at a planet's station for sale at some other station. A long-range chart is available, as well as a short-range chart, to show you nearby star systems. The computer can also give you information about the system, including current technological level and what race the inhabitants are. From this, you can hazard a guess as to what a planet might be buying.

Hyperspace travel is available, but you will have to use your ship's compass (located on your console) to head

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THE EXTREMISTS

"Extremist" is a term commonly used to mean "a fanatic of the opposite opinion." But it's not always that simple.

Nick Jainschigg

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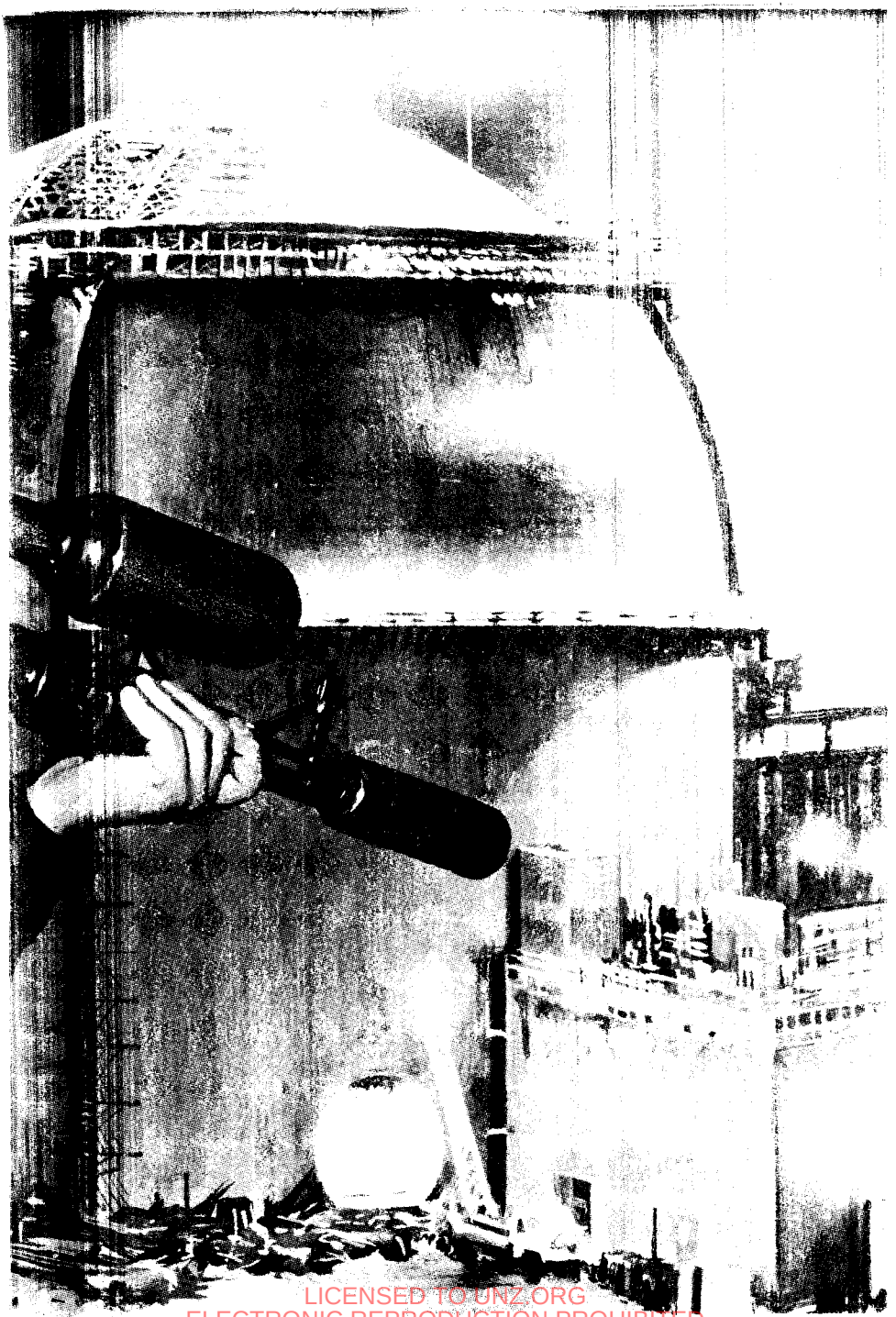

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1

The yellow lights burning around the abandoned nuclear power plant turned the two guards into perfect targets, Kent Sorenson thought. He adjusted the nightscope on his rifle, bringing the image of his man into sharp focus. Drawing shallow, steady breaths, he took aim and laid the crosshairs over the man's chest. Lying next to Sorenson on the beach sand, Michelle Holden went through the same process, aiming at the other Federal guard.

Out on the freeway, a truck horn hooted three times. "Okay, that's Romano." John Granger kept his voice low, although there was no chance that the guards could hear him. They were two hundred meters away, enjoying the moist night wind from the Pacific Ocean. The stiff breeze and surf noises would drown out any sounds the terrorists could make.

All but one sound, Sorenson thought, and grinned nervously. He had planted bombs before, but that was an abstract way of fighting the enemy. It was another matter to stare at a smiling face in a sniperscope and—

Granger gave a short count to synchronize the shots. Sorenson caressed the trigger, and the green-on-green image crumpled as his rifle bucked. So easy, he thought. He stood up and brushed off some sand. Without a second thought Sorenson picked up the fancy hunting rifle and jogged toward the chain-link fence.

The flatbed truck was already idling outside the gate when he got there. Vic Romano got out of the cab, clutching a set of heavy bolt-cutters. He went to the gate, hacked away its locks, and pushed the gate open. Sorenson saw him pause for a second as Romano caught sight of the dead guards. Romano's jaw clenched, and he hurried back into the truck cab. Sorenson and the other two terrorists climbed onto the flatbed, and held onto the stacks of railway ties while Romano drove them into the compound.

The San Onofre nuclear plant had been abandoned over twenty years ago, after the Los Angeles earthquake. Age, weather, and the sun had ravaged the buildings and equipment. Beach sand had drifted across the sun-warped asphalt roads, making the truck shake and rattle as though it were going through another earthquake.

The truck stopped alongside a temporary containment pool. It looked like a regular swimming pool, Sorenson thought, except for the rusting steel lattice that squatted in the water. The framework held fuel rods from the deactivated reactors, and a feeble blue glow surrounded the rods like a demonic aura.

Granger gave Sorenson a rough slap on the back as they stood by the pool's edge. "Goin' for a swim, fellow?"

"Hell, no." Sorenson forced a grin, just to show he wasn't scared. "Let's get started, fellow."

"You bet." Granger glanced at Holden. "Got the gloves?"

"Right here." While the three of them put on their lead-lined mittens, Romano went to the control shack at the edge of the pool. A computer-directed crane stood over the shed, dimly outlined by its safety lights. "I hope it still works," Sorenson muttered.

"It does," Holden assured him. "I watched them test it last month."

Granger laughed nastily. "You got

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to admit, the enemy is thorough. They'll never remove the wastes, but they keep up appearances—''

Worklights snapped on around the pool. With a screech of corroded metal, the derrick swung out over the pool. Its complicated grapple dipped into the water. It moved jerkily, as though afflicted by mechanical arthritis, and Sorenson guessed that somebody had scrimped on the repairs. Typical, he thought angrily.

Guided by the system's computer, Romano picked up a bundle of fuel rods and hoisted them into the air. Wobbling freely, the rods swayed over to the truck. Holden picked up her Geiger counter and waved its probe like a magic wand. ''Not bad,'' she announced cheerily, over the counter's vicious static squeal.

Using heavy tongs, the three of them wrestled the bundle onto the flatbed. While the crane went fishing for the next bundle they put some of the railway ties around the rods. During the long planning sessions, Sorenson recalled, Holden had assured everyone that the rods were almost safe—if they were kept properly separated from one another, to prevent a chain reaction. Holden was the nearest thing to a physicist in the Sere movement, and Sorenson hoped she knew enough to be right.

The raid was slow and hard work, Sorenson found. Handling the massive bundles in the near-dark was bad enough, but the simple fact of radiation made everything worse. The inky night shadows turned the rods into some slumbering primal terror, just waiting to lash out. Sorenson had to fight an urge to desert his duty and his fellows.

''Hey!'' he heard Granger blurt, several hours after they had started. The leader pointed to the horizon, where a red glow hung low in the sky. ''Why's the sun rising so soon?''

''That ain't the sun, fellow,'' Holden said. ''You're looking north, not east. That's the big brushfire. Don't you watch the news?''

Sorenson laughed. Granger had been an active revolutionary for years. Somehow, knowing that Granger felt edgy soothed Sorenson's own nerves like a pill. Checking his watch, Sorenson said, ''We've got over an hour until sunrise.''

''Twilight's going to start before that,'' Holden said. ''We can't risk having some pig spot us. We've got enough rods; let's retreat.''

''All right, Mickey,'' Granger said. ''Go tell Vic to move. Kent, let's get the cover over this stuff.''

While Holden ran over to the control shack, Sorenson and Granger spread a tarpaulin over the stack of rods and wooden ties. It had an ominous beauty, Sorenson thought, as he admired the shrouded pile. It represented enough poison to wipe out an entire city.

''One last thing,'' Granger said, as Sorenson climbed into the cab. Granger took a bundle of papers from the floor, and tossed them across the ground. The pamphlets and fliers had been gathered from a large number of environmentalist groups; left here, Sorenson thought, they would help to confuse the Feds—and to make trouble.

Settling into the cab, Sorenson checked his machine pistol and switched on the radios. The scanners would tell him if any cops were looking for the raiders, and the transmitters would let him divert

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the enemy with fake messages—or blanket their radios with raw noise.

The diesel motor labored heavily as the truck dragged out of the compound. Between the fuel rods and the cab's heavy shielding, the truck was grossly overweight and hard to maneuver. Sorenson felt it sway and skid as Romano worked it through some sharp turns.

"What's that, fellow?" Sorenson asked. He had seen Romano's lips move, but the engine roar masked his words.

Romano raised his voice. "Maybe we shouldn't have killed them."

"The guards? They're the enemy, fellow. Pigs."

"Yeah, and now the enemy can bag us all on murder-one hits."

"So we better not get bagged, fellow. We're committed." Which had been the whole point behind the killings, Sorenson thought. They couldn't afford to back out of this operation, not now. Things had become a matter of victory or death.

Sorenson looked in the rear-view mirror. Granger and Holden trailed behind in the van, covering the truck as it rolled into the sprawl of the Los Angeles Basin.

2

Inga Cardiff looked at her reflection in the mirror, straightened her cap, and nodded. A neatly tailored Aerospace Force uniform did wonders for her minimal looks, she decided, although she doubted that had anything to do with her mysterious recall to active duty. She was an engineer, an astronaut, and a pilot—a scarce and useful combination of talents.

The cyborg picked up the orders that had brought her to the Vandenberg spaceport. The clipped military phrases were banal and uninformative, but the papers had been signed by General Hargrave. Inga remembered him from her last tour of duty: a steady, thoughtful man, not given to issuing capricious orders. That alone suggested something pressing was in the works.

Inga left her apartment in the Transient Officers Quarters and stepped out into the blazing California afternoon. She could sense the changes in her thermal control system as it adjusted itself to cope with the record heat. The hot weather had driven most of the spaceport personnel indoors, Inga noted, but the temperature was within her operating limits. The only thing that made her uncomfortable was the notion that people were staring at her: a homely woman in full uniform, strolling through the scorching day without even sweating. Inga knew that she looked odd to normal people, and she could feel eyes tracking her.

The headquarters building was a fairly modern structure, erected just after the turn of the century. Inga took an elevator to the top floor and presented her orders to the receptionist. He glanced at them and pressed an intercom pad. "Major Cardiff is here, sir."

"Send her in," Hargrave's voice answered.

Inga entered Hargrave's austere, unpretentious office. The general stood at the window looking at a stain of black smoke along the southern horizon. A beefy, glowering civilian sat alongside the desk. He gave Inga a hard, unset-

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tling look. "Is *this* the officer you told me about?" he asked Hargrave.

Inga knew what he was seeing. Beneath her remarkably human exterior she was a collection of electronics, biochemical recyclers, and other hardware. The only organic part of her body was her brain; the astronaut had lost everything else to radiation poisoning in the aftermath of a solar flare. The bionicists who had constructed her cybernetic body had done their best to duplicate her original appearace, working on the theory that it would help her to retain a sense of human identity . . . and to get along with the rest of the human race. Things didn't always work out that way; the expression on the man's face told Inga that for whatever reason he had, he didn't care for her presence.

"This is Major Cardiff," Hargrave told the man. The general flashed him a sharp look as he sat down. Motioning for Inga to take a chair, he went on, "Inga, this is Louis Farrier, Director of the Counter-Terrorism Office. You've been assigned to provide him with technical advice."

"I don't want it," Farrier snapped to the general. "I know all about the Iron Maiden. You're giving me a walking computer. That may be a handy thing, but it can't compete with somebody who can *think*. Call me when you've got somebody who can do the job." He started to get up.

"Hold it," Hargrave said, his voice tight with controlled anger. "When you called this morning, you screamed for the best officer I could find. You said you wanted somebody with ingenuity and technical expertise. Here she is."

"What about its mental condition?" Farrier asked. "I've heard about its problems. General, I've got a serious problem on my hands, and I don't want it loused up because of glitches in this thing's programming."

He's putting on an act, Inga told herself. If she was going to work with him, Farrier would need to know how she handled pressure. Hence he was trying to provoke her.

And he knows which buttons to push, she thought wryly. After the accident, her radiation-damaged spinal cord had been replaced with a minicomputer. If there was a line which divided humans from machines, Inga no longer knew which side she stood on. At times she wondered if she was a robot, a machine activated by a dead woman's brain, carrying on a mockery of human behavior.

This is no time to get philosophical, Inga thought in irritation. "Why don't you tell me what you want?" she asked.

Farrier started to speak, but Hargrave overrode him. "Major, what do you know about the San Onofre nuclear site?"

"The usual things, sir. It was shut down after the Los Angeles earthquake. There'd been some rumors about its melting down, and that started a panic."

"It did," Hargrave nodded. "The damage to the reactors was minimal, but the government had to shut down most of the nuke plants in California, to allay public fears. Well, they built some new containment pools at San Onofre, and stored fuel rods from several sites there. The rods remained there until early this morning. Somebody attacked the plant, killed two guards, and made off with more than enough rods to energize a reactor."

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"Terrorists, sir?" Farrier's presence made that a logical guess.

"I suspect that," Farrier rumbled. "At least, I'm convinced that no foreign agents or organized criminals are involved—and several radical outfits have tried this type of thing in the past. That makes this a problem for the CTO.

"At the moment we're in the dark. An ordinary investigation will locate the terrorists, of course, but the President has suggested that the CTO employ outside help."

Inga thought that Farrier sounded resentful. The CTO had been formed in the Nineties, to combat the political unrest and terrorism spawned by that decade's economic disasters. The CTO had never been an outstanding success, and Inga wondered if Farrier saw the President's order as a comment on his competence.

"So I want some technical *advice*," Farrier continued. "Now, the President thinks that NASA could help us hunt out the fuel rods."

Inga nodded. "We have some asteroid prospecting gear that's designed to detect radioactive ores. It's all built for use in space, but we can adapt it for Earthside use." Inga turned to Hargrave. "But isn't this a job for the RadSafe unit, sir?"

"I'm afraid *not*," Hargrave said. "RadSafe's primary mission is to decontaminate known accident sites. They're not set up to hunt for needles in haystacks."

"So I have to hunt for the crap," Farrier said. "You can bet that these people will do something dangerous with it—either by design or by accident—so I have to find it fast. I can't spare the time to psych out your problems."

"I won't have any problems," Inga said, although she knew that was stretching the truth. She didn't want to risk a second exposure to radiation—although it probably wouldn't come to that, she consoled herself. Farrier only needed her to pinpoint the rods. "When do we get started?"

Hargrave scratched his chin. "It's your show, Major. How much time do you need?"

"Three days," Inga said promptly. "The lunar colony has all the gear and people we need, but it'll take that long to get things in order. I have a friend up there, a geologist, who can help arrange—"

"A colonist," Farrier grunted. "None of them can keep secrets. How reliable is this rock-hopper?"

"Quite reliable," Inga said. "How big a problem is secrecy?"

"It's as big a problem as panic," Farrier said. "The San Onofre panic killed hundreds of people, and the last thing we need is a repeat . . . and nuclear-armed terrorists have been everyone's favorite hobgoblin for decades."

Hargrave gave Farrier an amused glance. "If you still have any objections—"

"I do," Farrier spat, annoyed by the humor in Hargrave's voice. "For the record, General, I don't think that your robot belongs here. I doubt that its programming can handle a real-world situation—but I have my orders." He got up and stalked out of the office.

"Uh, Cardiff . . ." Inga had been about to follow Farrier out of the office. She stopped as Hargrave spoke to her.

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"Farrier is supposed to be a slick operator. There's more than bad manners behind his behavior, count on it."

"I know, sir." Inga hesitated. "Frankly, sir, I think he's heard so much about my mental state that he doubts I can do the job. He may think he has to bludgeon me into doing it—or at least make me prove I can handle pressure."

Hargrave looked dubious. "Maybe . . . I don't know. Whatever his problem is, Major, don't let him goad you into anything rash."

"No, sir." Inga smiled. It was a simple gesture, but she suddenly recalled how hard it had been to master such things, when she had been learning how to use her bionic body. "I don't have anything to prove to him." But to myself, she thought—that's something else.

3

"Haven't you fixed that thing yet?" Holden's voice was muffled by her dust mask and leaden hood. "We're losing time, fellow."

Romano glared at her through his goggles. "If you can fix this junker, bitch, *you* do it. Otherwise get the hell off my back." He bashed the winch motor with his hammer.

"Save it for the enemy, you two," Sorenson said. He had to raise his voice to make himself heard over the banshee howl of the windstorm. The Santa Ana wind tore at the building's sheet-metal roof and walls, rattling them with a noise like gunfire.

Romano's face turned toward Sorenson. "I can't fix this hoist, fellow," the mechanic said. "I think I gotta try something else."

"So *try* something else," Sorenson snapped. He stomped away, muttering to himself. The delays were bad for discipline, he thought, and the heat and heavy radiation suits didn't help. The building was like an oven. Wrapped in layers of cloth and lead foil, Sorenson felt like a baking potato.

He looked at the truck and its cargo. The nuclear wastes were right at home in this abandoned machine shop, he reflected. Its last occupants had left behind leaky drums of solvents, cleaners, and other poisons when they had moved out. A sump tank under the floor brimmed with lubricants. Outside the shop, a brace of electric transformers clung to a utility pole; spilled or burned, the liquid plastics in their cores could murder a city block. Even the flaking gray paint on the walls was hazardous.

And all of that hellbrew sat on one tiny patch of ground, Sorenson mused. Half of the world was as filthy and dead as this industrial slum, and the other half was sliding toward the same fate. It was up to him and his fellows to stop that, he knew.

Sorenson went into the dilapidated office, and sat down at the radio table. While he gulped tablets and tepid water, he monitored the police frequencies. There was plenty of activity, but none of it was local. This neighborhood was moribund and almost abandoned. Few criminals, and hence the police, wasted little time here. That was one of the factors that had made this area the perfect choice for Sere's plans.

Granger came into the office and dumped some envelopes onto the ratty metal table. "Mail call!" he declared. "Hey, our rent's due. The man gives

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us thirty days to pay up or get evicted." They both laughed at the paper threat. In less than thirty days, *they* would evict everyone from Los Angeles—or kill them.

"Vic's having trouble with the hoist," Sorenson said. He leaned back in his chair and loosened his makeshift radiation suit. "If he can't fix it, will we have to change the schedule?"

"I hope not. Mickey says we're already cutting it fine with our radiation exposures. An extra day or two might kill us—but nobody ever called revolution *safe*, did they?"

"Sure not," Sorenson agreed hastily. He didn't want anyone to think that he was a coward—but his fear of radiation was strong, and he knew it showed. He had faced police guns and riot gasses before, but this style of invisible, lingering death was a different matter.

". . . try to keep the schedule," Granger was saying. "We planned everything to create the maximum impact, so a big delay could screw us short. We'll have to work harder and faster, fellow. Remember, the next phase has to go down by dawn tomorrow."

"Right. I'll go check on Romano." Sorenson zipped up his suit and left the office. It relieved him to know that Granger wouldn't tolerate any delays. That improved his own chances of survival.

Romano and Holden stood atop the truck's flatbed, holding iron bars in their clumsy mittens. Their bulky lead suits made them look like astronauts, Sorenson thought with distaste. Prime examples of the enemy.

"Damned hoist motor burned out," Romano shouted over the wind. "So we'll get the rods down another way."

"How?"

"You'll see. Go fetch the saw."

Sorenson got the tool. He handled the machine carefully; even with the power off, its wafer blade could slice fingers like a laser. Just a typical, dangerous machine, he thought.

A loud crash made him jump. He looked, and realized that Romano and Holden had used their bars to pry a bundle from the stack of fuel rods. The aluminum bundle lay on the concrete floor, undamaged by its fall. "Start cutting," Holden called to Sorenson.

He cut. Two decades of immersion had corroded the tube capping, and the blade chopped it away in seconds. As it hissed through the metal, a plume of gray-brown dust spewed into the air. In a fit of imagination Sorenson found himself smelling the uranium oxide powder, despite his mask's filters. He could feel the hot dust motes insinuate themselves into his lungs, his balls, his bone marrow—

Cutting off that line of thought, Sorenson went to the other end of the bundle and opened it. Then he stepped back and let the others get to work.

Romano traded his bar for a long, stiff wire. He shoved it down one end of a tube, forcing fuel pellets to slide out the other end. Deftly, Holden scooped them into a plastic bag. As soon as one tube was empty, they set to work on the next one. Within minutes they had settled into a smooth, efficient rhythm.

Romano made a few jabs at one tube, stopped, and looked at Sorenson. "They're stuck," he said. "Corroded

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or something. I guess the pipes leaked water."

"Figures," Sorenson said. "What should we do?"

"Tell you what," Romano said. "You get a hammer and you tap on the pipes. You see if you can knock 'em loose."

"Okay," Sorenson said. Romano had placed just the faintest emphasis on each *you*, and Sorenson knew that the mechanic was gloating over his obvious fear.

Sorenson felt a sudden contempt for Romano, who had exposed his own weakness when he saw the dead guards. The man lacked the iron core which Sorenson had found in himself when he pulled the trigger. It had been good to find it, he thought; now Sorenson knew that he had the power to overcome any obstacle—the enemy, hardship, fear, even his own conscience.

4

The Los Angeles Federal Building was a squat, chunky fortress, which had been built shortly after the great earthquake. Its architecture reflected social conditions as well as tightened building standards, Inga thought, as she followed Farrier into it. The quake had disrupted the industrial and business life of California for several weeks. According to most economists, that had ignited the great depression of the Nineties, by jolting an economy already burdened with massive deficits and resource shortages. Unemployment and poverty had mushroomed, and as had happened in earlier depressions, desperate people had groped for any way out of the abyss. Some of them had turned to revolutionary politics, and at times their chances for success had looked good. The government had found itself on the defensive, and only the gradual return of prosperity had caused the threat to recede . . . to await the next crisis.

Farrier took Inga into his office and sat down, leaving the woman to stand while he read through a stack of memos. Plush as the office was, Inga noted that its only chair was the one Farrier occupied, which left no place for a visitor to sit. Standing didn't bother her, however; her contractile-plastic muscles never grew tired.

"Hargrave claims you're a genius," Farrier said, when he had finished the memos. He gave her the glowering look that he had shown during the long, silent car ride from Vandenberg. "So prove it. Tell me how you're going to find the rods."

That sounded more like a programming command than a request, Inga thought. Farrier's manner annoyed her, but she was willing to overlook it. "I'm not going to hunt for the rods," she said. "It's the fuel pellets inside the rods we want."

"Don't play word games with me, Cardiff."

"I'm not," Inga said. "The pellets are the important thing. They contain uranium, plutonium, and assorted decay products, and they all emit radiation. The obvious thing to do is to scan a large area with radiation detectors until we find the material."

"That could take months. Years. No good, Cardiff."

Inga shook her head. "We could use helicopters, and survey all of California within a few weeks. The pellets create

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an intense radiation source, so unless they're deeply buried, we'll find them."

"I don't know," Farrier said. "I'd rather rely on orthodox techniques. I can't afford to piss away my time with experiments."

He's being deliberately stubborn, Inga thought. "This won't interfere with your usual methods. Now, I can suggest other things, but it'd help if you could give me some idea of what these terrorists want."

"When I don't even know who they are?" Farrier scoffed. "Well—we know that a lot of radicals would love to have an A-bomb."

"That's out of the question," Inga asserted. "Turning spent nuclear fuel into an explosive device would require a lot of specialized, dangerous equipment and chemicals. It would also require thousands of highly trained specialists—nuclear physicists, chemical engineers, electronics engineers, radiologists, metallurgists, pyrotechnicians, tool and die makers, and so on. Nuclear weapons are complicated items."

"Scratch that, then," Farrier said, more to himself than to Inga. "People like that don't usually go into extremist politics."

"No? Why not?"

"If they've got the talent and patience to learn a complicated profession, then they're not likely to drop out of society. Most bomb-throwers are misfits; that held true even in the depression. What else can they try?"

"They could make a radiological weapon," Inga said. "They could mill the pellets into dust, and spread it over an area."

"What size area?"

"I couldn't say off-hand. There're too many variables." She considered things for a moment. "Radiological weapons are inefficient and hard to deploy. With what they have, they could make a very small area very dangerous, or they could turn several square kilometers into a long-term health hazard. The biggest problem would lie in dispersing the material—" Inga's voice trailed off.

"Wait a minute," she said suddenly. "If they wanted to produce *terror*, instead of actual damage, a radiological weapon would be ideal." She felt alarmed as the pieces began to fit together. "You don't need much skill to make powder, and they could scatter it on the wind. With the way this windstorm is blowing, they could contaminate a big chunk of Los Angeles—"

"We can rule that out," Farrier said.

"Why?" Inga asked. "It's quick, simple, and obvious—"

"But it's also counterproductive," Farrier told her, frowning. "Terrorists see themselves as freedom fighters, as revolutionaries, fighting *for* the people. They want to turn everyone against the government, not against them. Poisoning a city would turn them into public enemies."

"That assumes they want popular support," Inga said. "What if they're willing to swap that for panic and terror?"

Exasperation clouded Farrier's face. "You're too naive to understand how their minds work."

Inga rested her hands on the edge of the desk. "See if you can enlighten me," she suggested.

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Farrier's lips curled. "Very well. Consider this. Our terrorists left a lot of Verdant literature at San Onofre. The stuff was all pamphlets and leaflets, churned out by some of the biggest environmentalist groups."

"You didn't mention this before," Inga said.

"You didn't need to know it."

Inga felt a moment of annoyance, which passed before she spoke. "I can't help you without information. So why did they do it? Was it a diversion?"

"I *said* you were naive, Cardiff. It was more than that. The idea was to make trouble between the CTO and the Verdants. The big groups are all politically moderate, and they condemn terrorism—but a CTO investigation would suggest that we think they're implicated in this. That would anger them. Aside from pushing them to the left, it would create a lot of political pressure against the CTO, which would hamper my work. You might fall for that trick, but I won't."

"An investigation would do more than just anger them," Inga said. "It would tell everyone that something had happened. Maybe these terrorists wanted a little free publicity."

"Maybe you should leave the analyses to me," Farrier said. He drummed his fingers on the polished desk top. "I think they'll just bury the rods somewhere, probably in the desert."

"What's the point?" Inga asked.

"To create uncertainty and tension. They know that we *have* to find the crap—and the harder we have to work, the better. Terrorists love it when the CTO looks like a bungling circus." His frown turned thoughtful. "Aside from damaging our credibility, this mess could be meant to keep us too busy to meet a second threat."

"You mean that this is just a diversion?" The plastic muscles in her face did a fine job of expressing her doubt. "I'd hate to work on that assumption."

Farrier levelled a thick finger at her. "If you work on anything, it had better be those instruments you told me about. Your part in this investigation is a joke, Cardiff, but you may as well deliver the punch line . . . and stay out of my way while you do it."

He's scared of me, the cyborg thought. She knew that she had that effect on people, and some of them masked their fear with raw hostility. Knowing that, she found it pointless to become angry with Farrier. She would have to wait until he learned for himself that she wasn't a threat. Meanwhile, Inga told herself, she would have to endure his behavior.

"They killed two men," Inga reminded Farrier. "They're endangering their own lives. If they needed a diversion, they could've arranged something much simpler."

"But not half as effective," Farrier said, annoyed. "Cardiff, you have a certain *limited* function to fulfill, and wasting my time with detective games isn't part of it." He scribbled something on his memo pad. "You can use room two-twelve as an office. Just stay out of my way."

"Two-twelve." Inga took the paper from him.

"And whatever you do, keep this secret," Farrier warned her. "If this leaks out, it *will* start a panic—and it won't be *my* fault."

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"I can keep secrets," Inga said. "The question is, how long will the terrorists let us keep this secret?"

5

Like the radiation suits, the grinder was an ugly, clumsy thing, designed by Holden and built by Romano. In its test runs, it had ground chunks of brick into a fine ochre talc, but until now the machine had never received a proper workout. Now Sorenson dumped a bag of fuel pellets into its loading hopper. He nodded to Romano, and the mechanic turned on the power.

The grinder was noisy, and even louder than the wind-noises. The heavy pellets cracked and popped as they ran a gauntlet of blades, plates, and rollers. The grinder itself shook and chattered like a manic washing machine, banging its metal feet against the concrete floor. Sorenson took a step back from it, wondering if the machine would tear itself apart instead of working . . . but a fine, dark powder began to sift from its bottom spout, filling a plastic bag.

Holden consulted her watch, holding it close to her goggles. "We're doing better than I expected!" she bellowed, as Sorenson stepped up to her. "At the rate this mother works, we may even get ahead of schedule!"

"Good," Sorenson shouted back. "But we should've built a second grinder!" That would have made the work go twice as fast, and *that* would have cut his radiation dose in half, he thought glumly.

"We only need the one, fellow!" Holden bent down, removed the full dust bag from the spout, and snapped an empty bag into place. Heavy dust wafted through the air as she made the exchange. Holden carried the full bag into the storage room, holding it like a battle trophy, while Romano dumped more pellets into the hopper.

Sorenson and the others fell into a mind-numbing rhythm: load pellets into the machine, let the grinder pulverize them, and take away the end product. Sorenson couldn't tell how much progress they made. The supply of pellets seemed inexhaustible. In the noisy, furnace-hot shop, his sense of time grew hazy as he made endless trips between the grinder and the storeroom. Only the promise of destroying a city helped him to endure that. To carry the revolution to triumph—

"Let's take ten," Granger said, at some indeterminate point. He turned off the machine, and the end of the noise came as a shock to Sorenson. The mechanical thrashings had seeped into his mind until they became an integral part of his world. Without that noise, the wind's shiverings seemed like silence.

They filed into the office. Away from the worst of the heat and dust, Sorenson and the others shucked their suits and masks. Toweling sweat from his face, Sorenson slumped down against a wall and squeezed his eyes shut. He was so worn out that he lacked the strength to feel afraid of the radiation. That actually felt good.

"I think we should try something different," Sorenson heard Romano say. Opening his eyes, Sorenson saw Granger step up to the mechanic, pressing his face close to Romano's face.

"What's this, fellow?" Granger demanded. "Cold feet? Bourgeouis sentimentality?"

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"Strategy, Jack, strategy," Romano said. "We only have enough wastes to poison one city. Once we use it up, that's *it*. If we got to do it again—"

Holden stepped forward. "We've already settled that point, fellow. This attack is going to be the death blow against the enemy, so we don't need to plan more attacks. Holding back now would be a crime."

"Yeah, but we're gonna kill lots of people." Romano's tone was reasonable to the point of pleading. "That ain't right, is it? We're fighting to save the good people, not kill them—"

"They're all going to die anyway," Sorenson said. Exhausted as he was, he still forced himself to stand. He didn't want to burn his energy in a dialectical brawl, but he knew that Romano's cowardice would infect him if he didn't fight it. "It's inevitable."

Romano looked at Sorenson. "That don't mean we have to hurry anyone into their graves, does it?"

"We aren't doing that," Holden said. She ran fingers through her sweat-matted hair. "Look, Vic. There are eight billion or so people in the world. Eleven million of them live around Los Angeles, on desert land. The only way they can do that is by sucking in water from all over western America. That can't go on forever."

"Yeah, even the stupid Verdants know that—"

"The *real* point," Granger interrupted, "Is that the whole world is a mess like L.A. Nobody lives the way humans are meant to, and the problem isn't just grungy air and scummy water. It's robots, throwing decent people out of work, so they have to rot on welfare. It's computers and TVs, doing our thinking for us while our brains waste away. It's massive overpopulation, because the System equates 'more people' with 'more customers,' and the big executives don't *care*—"

"I know, I know, I know!" Romano was rattled by the way the others surrounded and harangued him, keeping him off-balance. "I'm no deviationist, fellows. I just want to know how killing the people we want to save makes us any better than the exploiters."

"It makes us much better than the System," Granger stated flatly. "The System kills because it's a parasite. It's going to suck the world until it's as dry and dead as the Moon—and that'll leave the human race dead! But *we* are striking at the System itself. It can't survive without its anthill cities. The people wouldn't be in any danger if the System didn't force them to live in those hellholes."

Romano clutched at his head. "I don't know any more. I think about it and I get all confused."

"Ignore anything that confuses you," Holden ordered him. "Be realistic. We have to kill the System before it guts the whole world. That's the only way we can find a *human* way to live."

"But not for everyone," Romano mumbled. "Billions of people can't all live off the bounty of the land."

"That isn't our fault," Sorenson said. "The System is guilty of causing overpopulation, to breed itself more workers and consumers. Sure, Nature can't support them—but a little dying now is better than complete extinction later, when the resources give out."

Holden nodded. "Nature may look

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cruel, but at least it never ignores problems like overpopulation. The System keeps bleating that it wiped out disease and famine—but does it ever blame itself for crime and ignorance and drug addiction? Or ghettos, or war? Hell, we're saviors, fellow, not killers."

Romano nodded heavily. "Yeah, I think that's right."

"Don't think, *know*." Granger shoved a dust mask into Romano's hands. Shaking his head in defeat, Romano got back into his suit and left the office, followed by Holden.

"He's going bad," Granger said, after the door shut. "He always was politically soft. What d'you think we should do about him?"

"Keep an eye on him," Sorenson said. It flattered him to have Granger request his opinion. Sorenson stood in awe of the leader, who had belonged to Sere during its heyday in the Nineties, and who had kept fighting even after so many others had quit. "Romano can't run away. The enemy never spares cop-killers, and he knows it."

"True—but he might do something stupid, like bust up the grinder. Damn him, why did he have to be the only decent mechanic we could find?"

"Most mechanics *like* the System and its technology," Sorenson said. "I just wish we didn't have to fight tech with tech. Well, I'll keep an eye on him."

"That might not be enough, fellow."

"I hear you." Sorenson picked up his radiation suit and got back into it. He found that he no longer felt weary. It would be a shame if he had to kill a fellow revolutionary . . . but it would be easy to execute a traitor. Sorenson told himself that it all depended on how he looked at the problem.

6

"Inga? Good to hear you again, girl." Janet Bedford's voice sounded delighted, although the interference between the telephone circuits and Inga's electronics added an odd burring to her words. "How are you?"

"I'm fine, Janet." Inga had last seen the lunar colonist a month ago, but somehow their separation seemed longer. The voice in the telephone earpiece made Inga feel homesick for the Moon—a feeling exacerbated by the dingy, depressing office Farrier had given her. "I'm not interrupting anything, am I?"

"No, Mac and I were just helping the kids with their schoolwork. How are things down in Pasadena? Are you and JPL getting the Saturn mission on-line?"

"No. I've been given another assignment." Inga hesitated, fingering a button on her uniform jacket. The radio uplink to the colony was supposed to be secure, but she knew how tenuous that privacy was. Just the same, she would have to accept the risk of an eavesdropper. "I need some help. You know a lot about prospecting, don't you?"

The geologist chuckled. "That's how I earn my salary. What exactly do you need?"

If I had any lungs, Inga thought, I'd take a deep breath. "Janet, somebody stole a large number of fuel rods from an old nuke plant this morning. They killed two men and vanished."

There was a long silence, much longer than could be accounted for by

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the time lag between the Earth and the Moon. "I—see," Janet said finally.

"Nobody can guess where they're hiding," Inga said. "My opinion is that they're somewhere in or around Los Angeles, but that's only because running too far and long with the wastes might kill the thieves."

"Hm. 'In or around Los Angeles' covers a lot of terrain. Well, I can see that the problem looks a lot like prospecting for hot ores."

Inga nodded absently. "The trouble is that prospecting is a lost art down here. Earthside mining can't compete with asteroid and lunar mining, so they don't have prospectors and their tools down here."

"But they do," Janet said in surprise.

"What! Where?"

"At the Houston training facility, of course. They have the best people and the newest equipment—who do you think trains new astrogeologists?"

"Oh." Inga had been to the NASA facility many times, and she felt embarrassed at not having thought of it earlier. Now she recalled how adept its staff was at solving unique problems, and that its gear was already adapted for Earthside use. "Thanks, Janet. This is going to save a lot of time."

"Good. Oh, and you might contact different universities. Some of their geology departments might help. Now, Inga. Why don't you tell me what's on your mind?"

"Nothing, Janet. Things are just hectic down here."

The telephone buzzed with a rude noise. "Inga, it isn't like you to miss the obvious—and you sound low. What's wrong?"

Inga wondered what to say. She had known Janet for six months, and she liked to think of the woman as her friend, but at times their relationship was an uneasy and unequal one. Janet was a happy, normal human being, and Inga didn't see how she could appreciate a cyborg's unique problems. On the other hand, Inga thought, Janet had always made every effort not to treat her like a freak.

"I'm having trouble with a man on this assignment," Inga said at last. "He's a good man, but he's under a big strain, and he's obviously uncomfortable around me."

"Uncomfortable, huh? What's he doing? Is it the usual childishness, or is this character showing some creativity?"

"Well—" Inga looked at her office. Half the lights were burned out, and there were dusty cartons stacked everywhere. This is a storage space, she realized: a place to dump unwanted hardware. "He's been treating me like a robot, and—well, I guess it's the only way he can hack being around me. I know I give a lot of people the creeps."

There was controlled exasperation in the voice from the Moon. "Inga, I love you like a sister, but sometimes you give me a pain in the ass! Why are you apologizing for someone who's giving *you* a hard time?"

"All I'm trying to do is figure out what makes him tick."

"Really? Why?"

Inga found herself at a loss for words. "I just feel like I *have* to understand," she managed to say.

She had a sudden vision of Janet rolling her eyes. "Know what you're really

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doing? You're hoping that he can tell you why you aren't human—and how to become human again. You think that people who hate you have some mystical reason for feeling that way—some spiritual revulsion. You expect to learn something about being human from that, don't you?"

"I—" Inga felt a pang. The words cut deep. "That's true enough."

"And it's a crock! Inga, you *are* human—one of the best. You deserve a lot of respect. The next time some schmuck doesn't show it, spit in his eye."

"I'm not equipped to spit."

"Then tell him to go to hell—and mean it!" Janet ordered. "You have no reason to feel inferior. You're as human as anyone else."

"I don't know about that." Inga found it hard to speak. It was as though she were confessing a crime, rather than confiding in her best friend. "You know that when they rebuilt me, they had to replace my spinal column with a neuristor array—a small computer. That means that part of my *mind* is a machine—and we define humanity by the way we think."

"And you think, Inga. You've got a human mind."

"I'm not so sure of that any more." Inga's free hand worried at the telephone cord. "You know that I don't need to sleep—and when I use my sleep inducer, I don't dream. That isn't normal or healthy, but I'm still functional. Do you know how the bionicists explain it?"

"No, I don't." Janet sounded at once troubled and darkly fascinated.

"They tell me that dreams are the subconscious mind's way of analyzing experiences and emotions. During the waking hours, you build up a backlog of experiences and memories. When you sleep, the subconscious processes everthing in the stack, putting it into perspective and integrating it into your personality. If you don't do that, if you're prevented from dreaming, your personality deteriorates.

"There's a different process at work in my mind. My neuristor array processes everything as it happens. There's no backlog of data waiting to be integrated into my psyche. I *can't* dream."

"Or have nightmares," Janet argued. "You don't have to sleep to *dream*, Inga. Anyway, maybe this real-time integration means that you're saner than the rest of us."

"Janet, the point is that part of my thinking processes involves a computer." Inga spoke rapidly; she knew that if she stopped or slowed down now, she might find it too hard to bring this up again—and she needed to talk about it. "When I was in rehabilitation, I had a lot of trouble with my neuristor array. The therapists had to keep reprogramming me—and I could *feel* it when they changed the software. I'd go autistic, or hallucinate, or feel emotions I can't describe. So I know that part of my personality isn't human—but I can't say how much I've lost."

"Or gained," Janet said doggedly.

"A lot of people wouldn't say I've gained anything. They must know something."

"Balls. They don't know *you*, Inga. You know what you should do? The next time anyone treats you like a robot, go on the attack. Ask questions, and

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keep pushing until you get explanations. You'll hear nothing but vicious garbage—and that'll help you, because you'll see that the only reasons anyone has for despising you are emotional, not logical."

"Janet, emotions are a basic part of human nature."

"Yes," the geologist countered, "And they include hatred, fear, and arrogance. Inga, you said that we define humanity by the ability to think. Maybe that means that the folks who let their emotions do their thinking aren't half as human as you. Think about that, will you?"

"Okay," Inga promised uneasily. Janet's advice was sound, she knew, but Inga didn't relish the prospect of debating her humanity—especially not with Farrier. Even if the man was a bigot, he wasn't a mindless one, and Inga was convinced that he could provide a strong defense for his position . . . one that she might not be able to refute. Somehow the *status quo* of uncertainty seemed preferable. "I have to go now. Thanks, Janet."

"Sure. Inga? Be careful down there."

Inga hung up the phone, feeling disconcerted. She wished that she could spare the time to grapple with this—but the problems of other people demanded her time. Later, she promised herself. Her problems could stay on hold until later.

She looked at the office window, which was speckled with soot from the Carbon Canyon brushfire. The windstorm had blown smoke and ash across the Los Angeles basin, as the hot, dry air funneled through the mountain passes which lay between the basin and the deserts. Like earthquakes, droughts, and wildfires, the gale-force east winds were a fact of life in California, and Inga felt certain that the terrorists had taken them into account. They had stolen the rods at a time when the forecasts called for a week of the desert winds, and the ashfall proved that the wind could easily spread dust over an enormous area. As a means of spreading terror, that was an obvious, almost elegant, technique.

Farrier's belief that the terrorists would do nothing with their booty struck Inga as illogical . . . but he might be right, she conceded. Farrier had dealt with terrorists for years, and he must have developed certain insights into their minds—just as Janet had done with her, the cyborg reflected. She was frustrated by the thought that everyone but she had that ability.

7

"All right, easy now," Romano told Sorenson as they lowered the last of the bundles to the ground. The empty tubes weren't too heavy, but the lead gloves made them hard to handle—and they made Hell's own noise if they simply dropped to the ground. That was the last thing Sorenson wanted on a commando raid like this.

Once the rods were down on the asphalt, Sorenson backed away from them. Empty or not, they still looked dangerous, and he was convinced that the metal itself was radioactive. To conceal his fear from Romano, he looked around the parking lot, as if scanning it for hostile forces.

He saw none. At three in the morning, the parking lot was empty. A few

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lights burned in the windows of the TV studios adjacent to the lot, and the studios' air conditioners hummed busily, but Sorenson neither saw nor heard anyone. Despite that, he peeled off his gloves and drew his machine pistol.

Holding the weapon casually, he watched Romano go on to the next task. The mechanic sprinted over to the studio's front door, and pasted sheets of paper to the glass plates. He hesitated for a moment, looked over his shoulder at Sorenson, and then shambled back to the truck.

As he climbed back into the cab, Sorenson kept his pistol out. He had no doubt that Romano had lost his nerve and no longer accepted the rightness of the Sere cause. Clearly, he would desert at the first chance. Sorenson would have preferred to shoot him now—but, regrettably, the revolution still needed Romano's talents.

The cab doors slammed shut and the motor revved up, breaking the night's silence. The wind had faded out after midnight, a fact which Sorenson found ominous. If the wind didn't return, then the attack wouldn't work, and everything would have been to no avail. Holden claimed that the weather wouldn't break, but Sorenson didn't know if he believed that. Everyone knew that the world's climate was all messed up, thanks to the experiments and depredations of the System. Nobody could guess what the weather might do next.

"I've been thinking," Romano said, as he spun the steering wheel. The truck lurched into the street. "Suppose the panic starts before we make the attack."

Sorenson shrugged, and hefted his pistol. "What if it does?"

"Well, panic is what we want, isn't it? The complete evacuation of this city. Once people see the rods on the TV news, and hear our ultimatum, they'll start to panic and run. You said so yourself."

"I did." Sorenson looked at Romano's pale face. Lit up by random streetlights and the dashboard lamps, Romano looked pale and tense. "But we want more than that."

"I know. We want people to know it ain't safe to stay in cities. Once they run out of them, the System will collapse. *But*—" Romano shifted gears and spun the truck around a corner "—they got to believe it can happen again and again."

"That's the first law of terrorism, fellow." Sorenson used the word without qualms. Sere was small and weak, Granger had told him, just like a virus. They could only destroy the System by infecting it with fear. Then the enemy would defeat himself, hunting foes in every shadow, while the people became afraid of incurring Sere's wrath. "Once we hit them, they'll know we can do it again and again."

"No, they won't." Romano smiled tightly. "They'll know we used up all the wastes we liberated."

"How'll they know?" Sorenson asked. "The System will tell them that. We'll tell them otherwise. Who'll they believe?"

"Us. Us." Romano nodded jerkily. "Look, fellow, why not postpone the attack by one day, just to see how things shape up?"

"Because time isn't on our side just yet," Sorenson said. "And there is no reason to wait. Once we make this at-

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tack, things happen automatically. The System will have to abandon Los Angeles. That will punch a hole in the economy, like happened after the earthquake. The System is rotten to the core, and when it loses its biggest city, *permanently*, it'll start to unravel and die, like dominoes falling."

"I still say one day can't hurt, fellow. It'll give the panic even more time to—" Romano saw something in the rear-view mirror, and his face went slack. "Oh, Jesus, Kent, we're dead—"

"Shut up. Keep cool." Sorenson saw it in a door-mirror: a black-and-white growler, with two cops in it. He wasn't afraid; Sorenson's first thought was that a battle, whatever the outcome, would give him an excuse not to return to the shop and its collection of wastes.

His second thought was of Romano, who had turned gray with panic. Keeping the pistol low on his lap, Sorenson pointed the muzzle at the driver. "Drive straight ahead. I don't think they're interested in us yet." He leaned forward and hit the buttons on the scanner. That was a county sheriff's car back there, but Sorenson heard nothing on their frequencies.

Watching through the mirrors—he was afraid to turn his head and look, which might have attracted the cops' attention—Sorenson studied the cops. They seemed to be joking with one another; they must not have spotted the phony plates on the truck. Then the growler slowed, and vanished down a side street. Relief and disappointment flooded through Sorenson as he holstered his pistol. "They didn't notice us." It almost offended him to be ignored by the enemy.

"You sure, fellow?"

"Yeah. I can't explain it, but I won't ask questions."

"Maybe they did recognize us," Romano said. "Maybe we oughtta ditch the truck and split up, run for—"

"Stuff that. Take us back to our base." Sorenson realized that the traitor did have one use. By fixing his hatred on Romano, Sorenson could forget his own fears.

The drive back to the shop was long and indirect, but Sorenson saw no more cops. It wasn't until after sunrise that they got back to the machine shop, and had the truck safely hidden behind its doors.

"Have any trouble?" Granger asked, as Sorenson climbed out of the cab.

"No," Sorenson said, and lowered his voice. "But Romano almost blew it for us."

"I thought he might. We'll have to take direct action with him, when we're done with him. Screw it. Did you get all the targets?"

Sorenson nodded happily. "We hit three TV stations and a newspaper. We left them plenty of rods and truthsheets." The targets had been chosen for their sensationalistic news styles. Their coverage would be fast and lurid, Sorenson thought, which was what Sere needed.

Granger patted Sorenson on the shoulder. "Well done, fellow. Now get back into your suit, okay?" He grinned. "Mickey says that, the way things are going, we can make the attack tomorrow morning."

"A whole day ahead of schedule? Great." Smiling, Sorenson hastened into the office, and climbed into his ra-

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diation suit. It reeked of dried sweat and body oils, but he didn't care. The promise of action made everything endurable.

Emerging from the office, he saw Holden spraying the floor with water. "Decontamination," she explained, before Sorenson could question her. "There's a lot of dust on the floor and walls. If I flush it out, it'll cut down on our exposures enormously."

"Good thinking, fellow." Sorenson watched the murky water sluice out under the front door, to run into the street. "But won't that mess up our lovely neighborhood?" he asked in feigned innocence.

"Yeah, it's really going to lower the old property values."

Sorenson laughed with her, and went to a window. The morning shadows were still long, but he could feel the sun burning through the dirty glass. Dust devils were spinning down the street and sidewalks as the wind stirred to life again. Sorenson took that as a good omen: Mother Nature was on the side of the revolution.

8

"Everything is set," Inga told Farrier as she walked into his office. "The search will be airborne by noon today."

"No doubt." The CTO chief gave Inga a foul look, and turned his attention back to the people standing around his desk. " 'Not a trace,' " he said mockingly. " 'Not a trace.' They left plenty of traces! Papers. Tire treads. Footprints. Fingerprints! Bullets inside two dead men! So don't tell me there's no trace of them!"

"None of it means anything yet, Bear," a woman said. "Most of the fingerprints are too smeared to read, and the ones we can make aren't on file anywhere. Any large truck could've left those tread marks, and the bullets are standard thirty-oh-six hunting slugs."

"And all we know about the papers," another agent said, "Is that they were all printed and distributed locally."

"I may have something," Inga said. She pulled a notepad from a uniform pocket. "There was a theft of lead foil in San Diego last month. Two weeks ago, somebody broke into a warehouse in Maywood and swiped a set of Geiger counters."

"How do you know?" Farrier demanded.

"I had a few hunches this morning," Inga explained, "So I got onto your computer net and started checking crime reports for—"

"You aren't cleared to use our net," Farrier said. He looked at the agents around him. "Who gave it access?"

"Nobody had to," Inga said, feeling miffed. "Your computer operators seem to think that 'security' means a good retirement plan, so I didn't need any help—and I have a security clearance. As I was about to say, I looked for thefts and registered purchases of anything that could be used to handle or process radioactive wastes. This is all I found." She gave Farrier the notepad.

" 'Lead foil,' " an agent repeated. "What's the connection?"

"Shielding," Farrier spat.

Inga nodded. "They could use the foil to make basic radiation suits. They'd be useless against heavy exposures, but that could protect them from low dosages."

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"Which means that the suits would be useless if they stayed near the rods," Farrier said. "That makes me think they've dumped the rods somewhere. There's a difference between suicidal and reckless."

"But what about stupidity, Bear?" an agent asked. She looked thoughtful. "You know the psych profiles for terrorists and extremists. Most of them aren't too bright, and even the smart ones don't understand technical stuff. They might figure that lead is lead, and any amount can protect them."

"Like a magic charm?" Farrier frowned, but he nodded at her. "Good point, Turner. Check it out." He gave her the notepad, and turned back to Inga. "Is there anything else?"

"A suggestion," Inga said. "Contact the medical community. In a few days or weeks, these terrorists are going to show symptoms of radiation sickness. Unless they're willing to crawl into a hole and die, they'll need drastic medical help: transfusions, antibiotics, chemotherapy and bone marrow transplants." And even that might not help, the cyborg thought. In her case, all the care on this world hadn't done anything more than to keep her alive long enough for the bionicists to salvage her brain.

Farrier was about to say something when another agent burst into his office. "The terrorists have surfaced," he said, dropping some papers onto the desk. "It's Scre. They left these papers and a whole mess of nuclear fuel rods all over the city. They're threatening to contaminate the entire Los Angeles basin. It's all over the news now."

Inga picked up a paper and read it. The turgid, Orwellian sentences confirmed her guesses, but she drew no satisfaction from that. If anything, the terrorists' boldness in declaring their plans increased her apprehension. "Farrier, they wouldn't tell us this if they thought we had a chance of stopping them."

"This could still be a ruse, Cardiff," Farrier said. "Terrorists lie whenever it suits them. Well, hell, they've blown our secrecy. Young, call the local and state authorities, and fill them in."

"*What?*" Inga blurted. "You haven't told them? Why not?"

"It's standard procedure," Farrier said. "Preventing panic is always a prime consideration. So is denying publicity to terrorists. The local cops—well, the yokels always make more trouble than they're worth."

"So we had a bunch of terrorists cruising around town this morning, and nobody knew that they should've been looking for them." Inga felt more confused than ever; she couldn't fathom Farrier's logic.

"Don't tell me how to do my job, Cardiff." Farrier looked at the agent who had brought the news. "Dixon, how fast can you arrange a press conference?"

The man laughed ruefully. "Bear, we must have fifty reporters down in the main lobby. They all want a statement."

"I'll give them one, all right." Farrier snapped his fingers at Inga. "And you're going to talk to them, too."

"I have to get down to the El Toro Marine base," Inga said quickly. The last thing she wantd to do was to face the media. "The search—"

"It can wait. This can't. Come on."

Inga trailed him into the hallway.

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Farrier walked down the corridors at a brisk pace, forcing Inga to hustle to keep up with him. "I don't know anything about Sere," she said. "What can you tell me about them?"

"Nothing that matters to you."

Inga decided to act on Janet's advice; if nothing else, Farrier's attitude toward her was interfering with her duties. "Farrier, what's your problem? Are you scared of me?"

"Of you? Don't be ridiculous."

A real he-man, Inga thought sourly. "Then what have you got against me?"

"Enough. You don't belong here. You have no experience with police investigations—and your psych problems are no secret. Despite that, I've got orders to coddle you."

Inga felt certain that he wasn't telling everything, but what he had said gave her a handle on the situation. "Farrier, I have my problems under control. Now, I've already helped you—but if you won't cooperate, I may as well quit." She waited to see if he would call her bluff.

"I can't have that, I suppose. Okay, what do you want?"

"Information." Inga decided not to press Farrier about his attitude toward her. The decision left her feeling spineless—but right now getting information about Sere was more important. "What is Sere? What does it want?"

"It's a radical back-to-nature group—although it doesn't mind dirtying its hands with weaons and such. Its main thesis is that mankind evolved in a wild, natural environment, and we can only survive by returning to nature. All of our problems stem from human nature's basic incompatibility with science and technology."

"People have been saying things like that since the start of the Industrial Revolution," Inga said in annoyance. "Maybe they've forgotten that 'living with nature' means watching half your children die young, or starving when the crops fail, or—aw, nuts. How do they plan to change things?"

Farrier's laugh was short and harsh. "Through revolution. Sere claims that our society is so fragile and rotten that it'll fall apart with one good kick. When it goes, science and technology will vanish, along with a nebulous ruling class it calls the 'System.' Then our instincts will take over and create a human utopia."

"Humans don't have instincts. They—we have intelligence instead. How can anyone believe that stuff?"

"When you're broke and hungry, it's easy." He gave her a contemptuous look. "Cardiff, where in blazes were you during the depression?"

"Well, I was in the old Air Force Academy when it started, and—"

"—and then you were an officer, and then an astronaut. So you led a sheltered life, I'll bet." They came to an elevator and Farrier hit its button. "Cardiff, I'll agree that Sere's doctrines are demented. Its hard-core members are hooked on violence, or hypnotized by their own revolutionary mystique. Well, that was also true of the Nazis, the Communists, the Klan, and hundreds of other groups throughout history—but lots of normal people have followed their lines. Do you know why?" he asked condescendingly.

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"Damn it, Farrier, if I knew I wouldn't need to ask."

His smile was grudging, but it was a smile. "All right. It's obvious that people want answers and actions that satisfy their needs. During the depression, people felt abandoned by society, betrayed. Then groups like Sere came along, with elaborate explanations of what had gone wrong, and plans to set the world to right again. The bulk of the people who went in for extremism were just too desperate to care about the implications of everything they did."

"I see," Inga said. It was an alien type of logic, but she could follow its workings. "But why is Sere still around? The depression is over, and—"

"—and everyone's happy again." The elevator doors hissed open and they stepped into the lift. "Well, we still have problems. You ought to know, little miss astronaut, that your asteroid mines have put a lot of American miners and steel-workers out of business. You need a technical degree to get a factory job—if a robot isn't doing the work already. Cardiff, as long as technology can make people obsolete, we'll always have dissatisfaction and unrest."

"You're saying that we'll never get rid of groups like Sere."

Farrier sighed. "Every society has malcontents. That's why America still needs the CTO. This is a job for professionals."

The elevator stopped and opened its door into the lobby of the Federal building. As promised, reporters thronged the lobby—and Inga found herself in trouble. Bands of static clouded her vision, and her knees locked, forcing her to walk out the elevator with a stiff-legged gait. I'm being jammed, she realized, as she saw a number of TV pocketcams. Their microwave emissions were playing hob with her circuits, and she was afraid to wonder what might happen to her primary systems if the jamming worsened.

Farrier addressed himself to the reporters. "Before Major Cardiff and I take any questions, I have a statement for you. Yesterday morning, a small group of terrorists . . ."

Inga barely heard his recitation of events. The jamming was hard enough to take without the added burden of confronting journalists. Although she was something of a public figure, both NASA and the bionicists had worked to shield her from public attention. Inga felt grateful for that; she didn't want to serve as a sideshow exhibit. The only drawback was that the press had replaced information with embarrassing speculations.

". . . investigating some major leads now," Farrier was telling the crowd. He had a magnetic, authoritative presence, which Inga found far more attractive than the side of him she had seen before. "Thanks to Major Cardiff, the CTO has uncovered some crimes linked to this act, and we're checking the details now."

"How long will it take to catch these people?" someone asked.

"Not as long as *they* expect," Farrier said. "I can't tell you everything, of course, but you'll want to know that a search for the wastes is about to begin. Major Cardiff will give you the details."

"Major? What sort of a search is this?"

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Inga tried to find the source of the voice, but the static hashing her eyesight made that impossible. "It's a radiological search," Inga answered, and felt relieved to know that her voder hadn't malfunctioned. "We're going to borrow some Marine Corps helicopters, and overfly southern California until we find something. The wastes aren't especially hot, but our instruments are designed to detect very low radiation levels."

Her eyesight cleared just long enough to let her see a reporter shove her way to the front of the crowd. "Major, we know that these wastes contain plutonium, which is the deadliest substance on Earth. Just how grave is the danger, and when will Los Angeles be evacuated?"

She's looking for a scare statement, Inga realized. If anything, the public would need reassurance now—and Inga saw a way for her to give it. It would even allow her to put the media's interest in her to good use, an oddly pleasing thought. "I've been fried before," she said bluntly. "If I thought there was any serious danger here, I'd run like hell. Instead I'm looking for the wastes, and I intend to find them."

Farrier spoke again. "We're very short on time, and I'm sure you'd all rather have us out looking for the terrorists, instead of talking about them. Our public information officer will keep you informed. Thank you."

Inga felt unpleasantly conspicuous as she followed Farrier into the windswept parking lot. With her knees frozen, she felt that her walk made her look like Frankenstein's monster. Then the interference ended, and she was all right again. "Farrier, I don't think we did much to reassure the public."

"I wasn't trying to do that," he said. "That's an impossible task, unfortunately. I was trying to neutralize Sere instead."

"Huh? How?"

"With you. Look at yourself through their eyes. You're the epitome of everything Sere hates. I set you in front of the press as bait."

"Bait?" Inga repeated blankly.

He nodded. "Why do you think I wasted my time with the press? Cardiff, I don't trust nifty technical solutions like your search—but I *do* trust human nature. Once Sere knows that *you* are hunting them, I expect them to try to attract your attention, just to force a showdown with you—and when that happens, I'll have them."

That might work, Inga thought—but it stung her to know that Farrier had manipulated her. "Why didn't you ask me first? I don't mind taking risks, but I want—"

"I didn't see any reason to ask. After all, *you* are here to help *me* with this case."

"That still gives you no right to use me," Inga said. Her sense of outrage had faded in an instant, but a feeling of wariness replaced it. Farrier clearly thought of her as a machine, and he might not hesitate to sacrifice her to do his job.

"I have the right to do anything that'll help me crush Sere," he said. "Have you got any idea of what a menace they represent?"

"They can hurt a lot of people, mess up part of this city—"

Farrier waved her to silence. "Then

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you have no idea. Cardiff, every time there's a successful terrorist assault, it inspires copycats. More importantly, Los Angeles is an important part of the American economic structure. If something happens to even part of this region—well, it won't bring the depression back, but it would cause a lot of disruption, which would fuel the extremist groups."

Inga snorted. It was a passable snort, although produced by her voder, with no lungs behind it. "Farrier, you still could've asked me. We're supposed to cooperate, remember?"

"No—you're supposed to work for me, remember? I'm in charge here, and if you don't like the way I run my show, that's too bad."

As he walked away from her, Inga found herself thinking of Janet Bedford. When they had first met, Janet had been scared of the cyborg—and with good reason, Inga conceded; she had acted like a robot then. Yet Janet had overcome her fear, and developed into a close friend. Now Inga saw that, in the back of her mind, she had hoped that something like that might happen with Farrier.

I don't want that any more, she thought—but I'm still going to understand what makes his mind work, even if it kills me.

Which seemed possible.

9

Ashes from the brushfire had sifted down over the area shortly after dawn. The gray ashes had been harmless, but somehow a rumor had started that they were Sere's radioactive dust. Within minutes cars and trucks had begun roaring out of the run-down industrial park, as people began a mindless stampede. Sorenson and the others had watched the spectacle from the safety of the shop. It was a delightful foretaste of things to come—and as Holden had pointed out, the exodus meant that nobody was left here to spot them and report them to the enemy. Sere could work in safety now.

That suited Sorenson. After things quieted down, he went out to the sewer manhole in the parking lot next to the shop. The manhole was old, but large and serviceable: the earthquake and subsequent years of neglect hadn't harmed it. Sorenson spent most of the hot, windy day turning it into a weapon.

After he had plugged its drains with rocks and quick-setting cement, he loaded several tonnes of plastic explosive into its bottom. Sorenson had never used so much plastique before, and he took meticulous care as he stacked the containers and laced blasting caps into the doughy material. The possibility of a misfire at the big moment worried him; once buried under the wastes, his bomb would be out of reach and impossible to fix.

But everything would work, he told himself, as he crimped wires into the blasting caps. Some time tomorrow morning, a volcanic flame would thrust the poison high into the sky, to rain down on the city—

"Kent! Get in here!" The wind had blown a nervous, ragged quaver into Granger's voice. Sorenson dashed into the office, gripping his pistol, expecting trouble. He found Granger and Romano in the office, staring at a newspaper which Granger himself had liberated

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earlier. "Look at this," Granger said, smacking the front page.

Sorenson skimmed the sheet, while Holden entered the office and peered over his shoulder. The electrostat page bore heartening signs of the panic: bland official lies about the danger, photos of jammed freeways, alarming truths about radiation, even distorted facts about Sere itself. The press was doing a wonderful job of inciting panic, Sorenson reflected, as it clamored for a bigger audience.

"We have to speed things up," Granger told the others. "Mickey, is there any way we can be ready tonight, before the wind slacks off?"

"No," Holden said. "We aren't that far ahead of schedule."

"What's the rush?" Sorenson asked.

"You jackass! Look!" Granger pointed at a picture on the flimsy stat sheet: a beefy man in a dark suit and sunglasses, and an ugly little broad in a military uniform. "They've got the Iron Maiden hunting for us," Granger said.

"Christ on a crutch," Sorenson muttered. "Thinga has all sorts of instruments built into it, doesn't it? And it's strong. If that monster catches us—"

"Don't be an idiot," Holden sneered. "Tin Lizzie is just a fancy cripple, not a superwoman. Don't you airheads know anything?"

"All I know is what I hear," Granger said. "And what I hear—"

"—is mostly wrong," Holden said. "The Iron Maiden doesn't have any special instruments built in, and its technocrap muscles are weak as hell. When they built it, the System wanted it to look human, to fool people. That limited what the engineers could do."

"Are you sure?" Sorenson asked. All at once, he wondered if he could trust Holden. She had studied science for a year at college, before she had rebelled against its rigid mathematical dogmas. All of her exposure to science and its peculiar logics could have tainted her mind, he thought, and her loyalty.

"Of course I'm sure! All the Iron Maiden can do is scare us, and—" she glared at the three men "—I'd say it's doing that."

Granger looked relieved. "I'm glad to hear that, Mickey. I was afraid we'd have to change our plans."

"Maybe we should, anyway," Romano said, breaking his silence. "Thinga is the System's pride and joy: a woman turned into a robot. That's what they'd like to do to everyone, right? Now, why don't we *let* it find us—and then blow it away, just before we blow up the bomb?" Romano spoke eagerly, almost imploringly. "It'd make a great propaganda show, wouldn't it?"

"A genuine windfall," Granger deadpanned, fixing his sharp eyes on Romano. "What makes you think it would show up here alone? We could end up battling hundreds of pigs—and soldiers, with tanks and flamethrowers."

"We wouldn't have to fight it," Romano said. "Think! If we set off the bomb when the Iron Maiden gets here, we could say that it was responsible—that it tried to disarm the bomb, and screwed up. Then everything would be *its* fault."

Holden looked disgusted. "And we'd have to hold off pushing the button until it got here, right?"

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"It wouldn't have a reason to hunt us *after* we destroyed the city," Romano said stiffly.

"And delay means the attack might fail," Granger said. "It would leave more time for things to go wrong."

"It's only a tiny risk, fellows! It's icing on our cake!"

"It's a distraction," Granger said. "This robot is just a toy. Crunching it can't help the cause."

"But it can!" Romano said. "It'll make the enemy look even worse, expose more of their weakness, if their best tool can't beat us—"

"Shut up!" Granger bellowed. He took a single step, placing himself between Romano and the door. "I'm sick of your weepy sentimentality. Anyone can see you want this operation to fail. That's why you want us to take such a stupid risk."

"But we've taken bigger risks!" Romano protested. "Stealing the rods. Handling them like we've done. Murders. All the thefts and robberies and stuff, just to keep fighting." Romano picked up the newspaper and tossed it away, flinging stat sheets all over the office. "Even going out and buying this stupid newspaper! Did you buy it for information, or did your overstuffed ego want to see itself in—"

Sorenson whipped out his pistol and shot Romano. The heavy slugs caught him in the chest and hurled the man into a corner, while the report of the gunshots crashed through the stifling air like sledgehammer blows. Romano was dead before he hit the greasy tile floor.

"He had his chance," Holden said in the ringing silence that followed. "But he wouldn't listen to reason. Well, it was justice."

"A coward and a traitor," Granger said, with undisguised sadness in his voice. "But I wish I knew where I went wrong with the poor—"

"Shut up, you two," Sorenson said casually. For the first time since this had all started, he felt relaxed, as if he had just had a woman. "Let's get back to work."

For a second, he thought that Granger was going to say something. Then the leader backed down, and nodded. Seeing that, Sorenson realized that he had just taken command of Sere. It gratified him to know that power now rested in his hands. Turning to Holden, he asked, "We *will* be ready by tomorrow morning, won't we?"

"If the grinder doesn't break down." She licked her chapped lips and looked at the dead mechanic.

"Don't worry about that," Sorenson told her. "If we have any pellets left, we'll toss them into the hole, and let the explosion bust 'em up. Now, Jack, I want you to go out and phone our media friends. Tell them that we're punching the button at noon tomorrow."

"We'll be ready hours before then," Holden reminded him.

"I know." Sorenson's smile was almost a snarl. "And we're going to hit it just as soon as there's enough wind. We'll just announce that the enemy attacked us and forced us to take action. The people will accept that, naturally." The traitor had had a good point there, Sorenson thought placidly. It was important that the people blame the System for whatever happened—and he would

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give them plenty of things to blame on the enemy.

10

The helicopter dipped and twisted as the pilot fought it to a landing. Sitting in the door gunner's seat, clutching at the radiation instruments bolted to the door frame, Inga watched the runway skid below her. Then there was a jolt as the dumbo touched down. The pilot killed the bulbous aircraft's turbines, while Inga unstrapped and hopped to the ground.

It had been a nerve-wracking way to fly, she thought: sitting with her feet dangling over the door's edge, while the helicopter spun up and down on the gusting wind. Inga wished that there had been a better way to do things. Unfortunately, the radiation detectors had to be out in the open, unshielded by the aircraft's metal fuselage, and within fifty meters of the ground—or less, in a particularly violent downdraft.

Unchecked by buildings or other obstacles, the wind ripped across the flat expanse of the Marine Corps airfield. The sun was setting now, but it would take hours for the eastern deserts to cool down. Until they did, their heat reservoir would continue to drive the wind, making low altitude night flights impossible—or at least suicidal.

Inga went to the operations building and joined the rest of her team there. Marine aviators, NASA technicians, university people, CTO and Civil Defense operatives—the task force was a hodgepodge thing, but so far Inga hadn't noticed any coordination problems or interservice rivalries. After dealing with Farrier, it was a relief to work with people who made common sense look common.

"Nothing so far," Joachim Torreon said as he gave Inga a clipboard. He was one of the NASA techs, a retired astronaut who had joined the Houston training facility after his last mission. "We've found every antique radium watch-dial in town, but that's no help."

Inga nodded as she read the tallied figures. After covering a bare sixth of the search area, none of her five search units—all that were available—had found anything meaningful. The terrorists remained well hidden, and the odds favored them. More searchers and equipment would trickle in over the next few days, but Inga feared that the extra help would arrive too late.

She looked at the map on the room's central table. The search pattern overlaying it had been drawn up with a computer, and it was predicated on certain factors, such as wind conditions and terrain. In order to inflict the most damage on the city, Sere would have to release its pulverized wastes from one of the mountains east of the city; for convenience and security, they would have to have placed their hideout within a few kilometers of such a spot.

The logic was flawless, Inga thought as she turned away from the table. The only trouble was that Sere hadn't elected to do the most efficient thing possible. The terrorists were working according to their own plans and assumptions. Inga couldn't guess what they were, and it humiliated her to realize that she couldn't outthink them.

Angela Seggerson approached Inga, and handed her a thick wad of papers. "This might interest you," the pro-

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grammer told Inga. "It's the CTO file on our playmates. I didn't find anything useful in it, but I may have missed something."

Inga riffled through the pages. "Where did you get this?"

"I hacked it out of the CTO computers." Angela went on defensively, "I tried to get proper authorization, but Farrier killed it. That prima donna gave me some nonsense about not trusting bungling amateurs with classified data. He sounded like we were a bigger menace than Sere."

"To him, we are." Joachim grinned wickedly. "Should we find Sere, Farrier must share the credit with us. That will not enhance his prestige in Washington. He would be most happy to rid himself of us."

"Just try to ignore him," Inga said. The truth, she knew, was that Farrier didn't want her around. Fortunately, he didn't play a major role in the search.

Shaking her head, Inga sat down in a corner of the crowded room and read the material. It included dossiers on Sere's leaders, surveillance reports, interrogation transcripts, and Sere propaganda tracts. As Inga read, it became clear that Sere's members were even more limited than Farrier had suggested. They defined life in terms of violence and cataclysmic change, and they acknowledged no other possibilities. As with Lysenko, Velikovsky, and Hitler's "Aryan scientists," they thought of science and nature as things they could mold to suit wishful thinking and ideology. They were adept at rationalizing away anything that contradicted their viewpoints.

In short, Inga thought, they were extremists. She knew that the file should have told her something, but the knowledge eluded her. She set the papers aside, feeling lost.

"Cardiff!" Inga stood up, and saw Farrier moving through the crowd toward her. "You're supposed to be up in the air. What the devil are you doing down here?"

"It's impossible to fly now," Inga told him "Have you ever tried to fly a chopper at low altitude on a night like this? The danger—"

"You'll have to risk it," Farrier said. "We just got a message from Sere. They plan to dust the city at noon tomorrow. You people had better act fast."

Joachim appeared at Inga's side. "I thought that you lacked confidence in us."

"I do. You people are nothing more than a long shot—but the President doesn't agree." Farrier grimaced. "I was ordered to drop what I was doing, and come down here to check on your progress. There's a lot of pressure on the President, and on me, to get results."

"We're doing the best we can," Inga said. "This is no time to drag in politics."

Farrier laughed in disgust. "You're a fine one to say that."

"What's that supposed to mean?"

"Why do you think you're here?" Farrier jabbed Inga's shoulder with a finger. "Politics! NASA spent a lot of money building you. People resent that. NASA would like to prove that it wasn't wasted money—so when they saw a chance to do some grandstanding here, they grabbed it. They're too concerned

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with scoring political points to care if they endanger the public."

"And you believe that?" Joachim asked in disdain.

"Politics makes the world go round," Farrier said. "And there are jackals everywhere. Right now, every politician in this country is busy telling the media that they aren't responsible for the mess with Sere—but they're laying the heat on me, so they can look like they're working to protect the voters. They want to make sure that *they* don't get blamed if things go wrong."

Joachim's voice was dangerously cordial. "You, of course, are above such sordid maneuvering."

A flush darkened Farrier's face. "When I want your opinion, mister, I'll ask for it."

This has got to stop, Inga thought, as she saw the angry faces around her. "Farrier, if Sere gets away with this, there'll be plenty of blame for everyone. Now, maybe NASA pulled some strings to get me involved here. I don't know about that, and I'd say it doesn't matter right now. The question is, are we going to fight Sere, or ourselves?"

Farrier looked scornful. "I'd say I don't have much choice. All right, Cardiff, what do you want?"

"I said it before—information." Inga hesitated. There had been gaps in the Sere file—things that Farrier might know, but hadn't recorded. "For example, how many people are in Sere?"

"We're dealing with a splinter faction," the CTO chief answered slowly. "My best estimate is four or five people."

"Is that all?" Angela Seggerson asked in surprise.

"What did you expect, an army?" Farrier asked.

"I did." The programmer gestured at the map table. "When I drew up the search plan, I assumed that there were enough of them to let them spread out—hell," she concluded. "This changes everything."

"You mentioned a message," Inga said to Farrier. "What was in it?"

"It was primarily meant to taunt us," Farrier said. "The gist of it was that they're going to detonate a 'dust bomb' at noon tomorrow. Cardiff, you told me that they couldn't make a bomb."

"They can't create an atomic explosion," Inga said. "But they can use regular explosives to blast the dust into the air, and scatter it like fallout. It's not an efficient technique, but—"

"It's the sort of dramatic spectacle that terrorists like," Farrier said. "It grabs attention. People can't miss it."

"How did you verify this call?" Joachim asked. "If it was a hoax—"

"Voiceprints," Farrier said. "The caller was John Dexter Granger, one of Sere's original members." He turned to Inga. "Cardiff, I hope you're done wasting my time with questions. I have *serious* work to get back to—and you and your people have to get back in the air at once."

"Farrier," Joachim said, "The wind will drop back to a safe level in another five or six hours. If we attempt to fly before then, we will have several crashes—and we cannot afford to sacrifice people and equipment, merely to suit you."

"How would *you* know it isn't safe to fly?" Farrier snapped.

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"I am a pilot," Joachim stated, "And I am quite experienced."

"I'm not interested in your boasts," Farrier said, with a fierceness Inga found surprising. "All I care about are results—and all I see is you lab-coat and ivory-tower types, sitting around when you should be doing your jobs!"

"I would be happy to fly now, if you would accompany me." Joachim glanced at the ceiling. The wind-sounds were muted, but audible through the wood. "Perhaps you would enjoy a flight on this lovely evening?"

"I've got better things to do than to listen to your ilk whine about danger," Farrier said angrily. "If you're too gutless—"

"That's enough," Inga said. For the first time, she felt offended by the man's behavior. "Farrier, I don't like hearing you talk to people the way you're supposed to talk to me—I mean, the way you've *been* talking to me." Inga stopped, puzzled by her slip of the tongue. Then she rallied and pressed on, "Nobody will fly again until *I* decide it's safe."

"Are you refusing my direct order to resume the search?" Farrier asked in formal tones.

"Yes, sir, I am so refusing," Inga stated, as though to a courtmartial. Then her voice turned deadly. "Farrier, I'm sick of your prima donna act, and I've had it with your whole attitude— especially the way you've been treating me." She hooked a thumb at the doorway. "Get the hell out of here."

"Very well, Major." His face betrayed nothing, but Inga could have sworn that she heard satisfaction in Farrier's voice.

"That man is a political hack," Joachim said, as the door swung shut behind Farrier. "He's obviously setting us up as scapegoats, to protect his own position."

"And he's succeeding," one of the Marine aviators said. "Major, the least he can do is to charge you with insubordination."

"I suppose he can," Inga said, in a distracted voice. Telling Farrier off should have given her some satisfaction, she thought, but her slip of the tongue had spoiled it. What had it meant? At least nobody else noticed it. "But Farrier doesn't matter any more. We're going to find Sere."

"How?" Joachim asked. "You're not giving in to Farrier, are you?"

"Absolutely not." Inga looked at the map table . . . and decided that her reading of the Sere file had told her something after all. "Get me a contour map of this area," she ordered.

Somebody produced a map, and unrolled it on the table. Studying it, Inga realized that the topography of southern California wasn't as simple as she might have wished. Despite that, she could pick out many of the features she had seen from orbit: the basin, the mountains ringing it, and the valleys and passes which cut through the mountain ranges.

"We've overestimated Sere," Inga said. "We did a perfect analysis of the situation, but we took the wrong approach. Instead of looking at wind vectors and optimum dispersal points, we should have asked ourselves how Sere would have tackled the problem."

"And how would they?" Angela

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asked. The programmer sounded both curious and annoyed.

"Well, they're not scientists," Inga said. "They don't trust science, and they don't understand it. They'd rather rely on hunches and feelings, and the only kind of information they trust is the sort of thing that 'everyone knows'—the obvious."

Angela snapped her fingers. "That's right! Funny, I read that in the file, but it didn't make an impression on me."

"But how does this help?" Joachim asked. "If these maniacs relied on intuition, they could have chosen any spot for their hideout."

"No," Inga said. "They'll have to release the dust from their hideout, because it'd be impossible for them to move tonnes of dust and explosives any distance—especially with everyone looking for them. So they must have located their hideout in a place where the wind blows hardest, and where it blows across the basin.

"Now, forget about fluid dynamics and meteorology," she continued. " 'Everybody knows' that the Santa Ana winds are funneled into the basin through mountain passes, like water flowing through a crack in a dam."

"That's right," one of the Marine pilots said. "At least, that's what the weather girl on the evening news always says."

Inga nodded, and began circling areas on the map. "So the best place for Sere's purposes would be in the mouth of one of these valleys, on the eastern edge of the basin."

"That could be right," Joachim said. "Those valleys—some of them point across the basin like shotgun barrels. But how many of these areas will we have to check? They may have split up into several groups."

"There aren't enough of them for that," Inga said. "We'll find them all in the same place."

"It makes sense, Major," one of the Marines said. "But you've circled quite a few areas. It'll take us, hm, eight hours or so to cover what you've marked out."

"That still gives us a good chance to beat them, if we catch them before the wind starts," Inga said.

"Does it?" Angela asked her. "What's to keep them from releasing the dust anyway?"

"What for?" Joachim countered. "Without the wind, they can't harm more than a tiny area. Uranium and plutonium compounds have enormous molecular weights. Without a strong wind to push them, the dust motes will fall like rocks."

"*I* know that," Angela said. "But what about the public? As far as they know, when radiation's involved, running is the only sensible thing to do. That's what happened after the earthquake, y'know."

"Sere wouldn't have a reason *not* to push the button, if we find them," somebody said. "They could set off their bomb just out of spite—or like Samson in the temple. What would they have to lose?"

"We can't do anything about that," Inga said, "So there's no point in worrying about it. Meanwhile—"

Inga stopped herself. She had been about to issue orders to prepare for the next flights—until she saw the tired, drained looks on the faces around her.

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The weather and work had taken their toll, and most of the people who had been flying had suffered from airsickness. Inga was impervious to such frailties, but it surprised her that she could forget other people weren't immune to them.

"Meanwhile," she resumed, "It'll be a few hours before we can fly again. You'd all better rest while you can."

11

"It's all ready now," Sorenson said as he plugged the detonator cable into the timer. "Turn this knob to connect the battery, and push this button to start the timer. Five minutes later—wow!"

"Just five minutes?" Holden asked, shaking her masked head. "Won't we need more time for our getaway?"

"No." Sorenson smiled behind his mas... "We just need enough time to drive to the end of the block. We'll watch things from there."

"Why?" Granger asked. "Isn't that dangerous?"

Sorenson laughed. "I've stood closer to bombs. I want to make sure that nobody stumbles across this place at the last minute. So we'll keep it covered."

"And then we'll run east," Granger said. "We'll catch less dust, retreating into the wind."

"Speaking of dust," Holden said, "We've still got some more to load into the hole."

"I'll take care of that," Sorenson said. "Meanwhile, you two can load our gear into the van."

The sun was just starting to rise as Sorenson toted the last of the dustbags to the manhole. The massive iron lid was back in place over the hole; it would keep the wind from disturbing the dust. The detonator cable ran through one of the lid's pry-holes, while a large funnel rested in the other. Sorenson slit open a bag, and poured the dust into the funnel.

He knew that he would hate to see this day end. The climax of the revolution . . . but the aftermath would be interesting. Somehow Sorenson doubted that the transition would be as swift and peaceful as Granger claimed. There would be more struggles for Sere to lead—for Sorenson to lead, when you got down to it. He had the will, the strength—

There was a steaming hiss, and the lid began to glow with a blue light. Sorenson backed away in fear, stumbling toward the shop.

"God!" Granger said. He stood in the doorway, gaping at the flickering blue glow on the ground. "What's happening?"

"I—I don't know," Holden said fearfully. "There—it must be some kind of chain reaction."

"How?" Sorenson demanded. "We didn't make a bomb or a reactor!"

"I don't know! They must've lied when they told me about chain reactions. But that funny light—they call it Cherenkov radiation, you see it whenever—"

"Mickey, are we dying?" Granger sounded idly curious.

"I suppose so," she said listlessly. "That—it must be pumping out neutrons and stuff like hell. Jack, maybe we should set off the bomb now, while we still can."

"There's not enough wind," Granger

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said. "But it won't be much longer before it starts blowing again."

"It better not," Holden said. "Hear that? Helicopters."

"Just one," Sorenson said. He no longer felt fear, or anger, or anything at all. He was dying, and all he wanted to do was to take some of the enemy down with him. "Let's get ready to greet them. We're going out in style."

12

Inga sat in the door gunner's seat, oblivious to the crew's chatter and the hissing interference of the chopper's radios. It was nighttime, and the world drifting below her feet was a tracework of lights on black satin. A freeway glimmered as a one-way stream of car lights, flowing out of the basin in an impromptu evacuation.

Although Inga had circled a half-dozen areas on the map, only one had struck her as being the most likely place to find Sere. She had chosen to search that area herself; she wasn't willing to let someone else take the greatest risks. That decision had been easy, and she had felt good about it as her helicopter lifted from the base . . . but after that, there had been the tedious flight to the search area, and that had left her with time to think.

Her slip of the tongue was preying on her mind. Inga hated it when somebody treated her like a machine, hated the idea that she was less than human. What would make her think that people were *supposed* to treat her that way? She had only tolerated that because she needed to know—

To know what? Nobody could tell her what she was, certainly not Farrier . . . yet she had endured Farrier's abuse without resentment. She couldn't understand why some part of her mind had chosen to accept it.

Inga wondered if she was capable of understanding anything. Farrier, for example—he hadn't fooled Hargrave, or Joachim, or Angela. Inga was the only one he had deceived.

No, she admitted, I deceived myself. Farrier's behavior had been clumsily transparent from the start, but she had insisted on reading arcane meanings into it. The CTO chief hadn't been uncomfortable around the cyborg; he had been trying to drive her away because he saw her as a competitor, somebody who posed a menace to his career. Now he was trying to set her up as a scapegoat, to save himself if things went wrong. I've seen his kind before, Inga thought; why wouldn't I let myself recognize him for what he is?

"Major?" a voice said in her headset. "We're over the initial point now. Ready to commence."

"Roger. Take us down to fifty meters, Lieutenant." With her problems still gnawing at her, Inga activated her instruments as the helicopter descended into the turbulent air near ground level.

The dumbo flew east, tracing out half-kilometer-wide strips as it zigzagged over the ground. On the map, the spot Inga had circled was an area the size of her thumb. From the air it seemed as big as all of outer space.

The survey dragged on for hours, through the night and into the dawn. Voices from the other searchers whispered in Inga's headset, telling of negative results, spurious readings, instrument failures. Inga remembered

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promising Farrier that she could survey all of California in a matter of weeks. Now every delay mocked her.

Shortly after sunrise Inga watched her readings climb quickly, then begin a slow drop. The brief spike in the readouts could have meant anything or nothing . . . no. "Circle around here," Inga ordered the pilot.

The helicopter spun around slowly. The sensors responded with faint but definite readings. Inga began speaking to the pilot, guiding his flight by changes in the radiation level. It rose in spurts, and kept rising, while the dumbo nosed through the air like a bloodhound sniffing a trail.

After a while Inga looked up from her instruments, bewildered by the readings. She had imagined that she would find a sharp source of radiation, something that would let her pinpoint the terrorists. Instead, several square kilometers of the decaying urban blocks below her were contaminated, with levels of radiation too intense for her sensitive meters to handle. Had Sere already released its dust? she wondered. Or had the terrorists had an accident of their own?

"We have to land," Inga told the pilot. "They're definitely in this area, but we'll have to search on foot. Put us down somewhere."

"Yes, ma'am." The pilot slanted his craft toward a wide intersection. "Should I call for reinforcements?"

"Yes. Warn them that this whole area is hot. The readings go off the scale at point-one rems per hour."

The helicopter landed in a flurry of dust, ashes, and paper scraps. Inga jumped clear of the machine, followed by a Marine corporal. The man had been assigned to act as Inga's bodyguard during landings; if the threat of radiation bothered him, he didn't let it show. He held onto his coal-scuttle helmet while the helicopter rose back into the sky.

"They could be hiding anywhere, Alvarez," Inga said quietly. There were thousands of seedy, dilapidated buildings in this area. The place looked as if it had been abandoned in panic, but Inga could imagine that the terrorists were watching her from any of the dark, anonymous windows around her.

"Any hunches on where to look, Major?" Alvarez asked.

"Not yet," Inga admitted. Think fast, she told herself. The wind was gaining strength rapidly. It would start blowing at full force long before she could search even a few dozen buildings, if she relied on luck alone.

The helicopter had dwindled into the distance, but the maddening radio interference with her circuits continued. It came as a cascade of unpleasant, undefinable sensations along one side of her body. Inga forced herself to ignore it as she began walking down the street, looking for anything that might betray the terrorists.

It was a hopeless task. Abandoned or evacuated, this industrial slum was a shambles. The terrorists would have had no trouble blending in here—which was probably one of their reasons for choosing this area. For all Inga knew, she could have landed in front of Sere's hideout without noticing them—

—and now the sensations were plaguing her back.

Inga stopped, puzzled, and turned around. As she turned, the sensations shifted, as if they were coming from a

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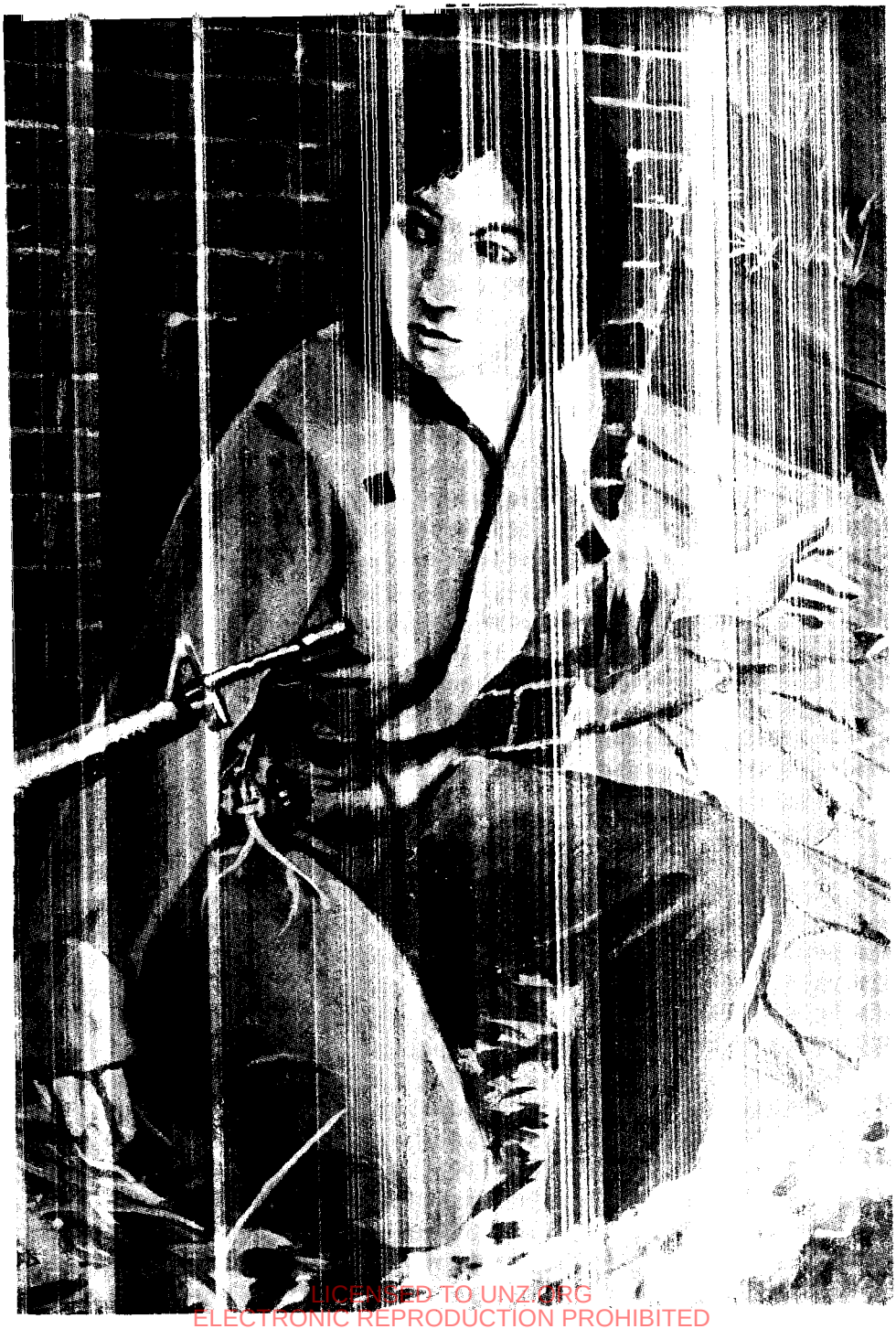

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source outside her body. Would Sere use electronics? she wondered suddenly. Radios, computers, waldoes, robots? It seemed possible. On an impulse she spread her arms and twisted back and forth, like an antenna homing on a radio beacon.

"Major? Are you all right?"

"I'm fine, Corporal." Inga laughed and pointed. "That way. They're in that direction."

The sensation grew more intense and unpleasant as she walked on. Inga gritted her artificial teeth and endured it. The sensation led her down a side street identical to a hundred others. It wasn't quite like listening to a sound or looking at a point of light . . . but it was a sense as real as any other kind, Inga thought, and it was telling her what she needed to know. That knowledge gave her an odd sense of satisfaction.

She and Alvarez had reached the end of a block, and were crossing an intersection when a burst of automatic weapons fire barked out. They dropped to the pavement and flattened themselves against the curb. "Alvarez!" Inga hissed. "You all right?"

"Yeah. I don't know how they missed us. Where are they?"

"Wait one." Inga raised her head. The sensation came from a gray building down the street. "They're in that big sheet-metal building, the one that says 'Waukegan Machine Tools.' Now let's get under cover."

The corporal dodged across the sidewalk, running into an alley. Inga scrabbled alongside him, limping and oddly off-balance. Glancing down, she saw ripped cloth and plastiflesh shreds dangling at her side. The bullet hadn't hit anything vital, but it had chopped through neuristor lines and a stringer. She felt no pain, but the damage hampered her movements.

From the alley entrance, Inga watched bits of paper and plastic scud down the street. A Marine battalion was flying in, but by the time its helicopters landed the wind would be strong enough to suit the terrorists' purpose. There was no way to duck the issue; it was up to her to stop the terrorists.

Sure, Inga thought wryly. I'll just pick up a building and drop it on them, like any proper TV cyborg. Physically, her cybernetic body was no match for a human body. She knew she couldn't outfight them.

So I'll outthink them, she promised herself.

Alvarez was cursing his wrist radio. "Major, I can't raise anyone."

"I know. Our playmates have some kind of radio jammer." Inga looked down the alleyway. "We need a better look at that building. Follow me."

They hurried down the alleyway, until they came to a building which sat across the street from the machine shop. Inga peered around a corner at the place. It stood between two large, empty parking lots. She spotted a line that ran from a broken window to a sewer manhole in one of the lots. That must be their weapon, Inga thought—and that explained the radiation surge she had detected. Sere had stolen more than enough fuel to energize a reactor, and the idiots had lumped it together, forming a critical mass—but without the safeguards and controls of a reactor. The chain reaction had probably burned itself out in a matter of minutes . . . but not before

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creating intensely radioactive fission products. The wastes were now far more dangerous than they had been before—

Inga jumped back at another wild blast of gunfire. Chunks of brick spalled off the corner of the building, while ricocheting bullets spanged through the air.

"I saw two of them, Major," Alvarez said hoarsely. "Looked like they were both wearing gas masks."

Inga nodded. That would have been an obvious precaution against the dust, and she guessed it was one of the few safety measures that terrorists had taken. Whatever sloppy technique they had used to make their dust, Sere had managed to contaminate a sizable area already. "Alvarez, did you see a wire running out of that place to a manhole?"

He nodded. "You figure it has something to do with their weapon?"

"I do," Inga said. "They're supposed to have a large bomb set up, with radioactive dust heaped on top of it. A sewer manhole would make an ideal container for it."

"And you think that line is for the detonator?"

"Yes. If we can cut it—" More gunfire drowned out her words.

"We'll have to rush them," Alvarez said.

"Don't be ridiculous," Inga said. There was no way that either of them could run across the street and into the lot. The terrorists had an excellent field of fire, and they couldn't miss a runner at such short range. Unless . . .

Inga peeked around the corner, and confirmed something that she had half-seen before. "Alvarez, did you notice those transformers on that utility pole?"

"Uh, I think I saw something like that, Major."

"Okay," Inga said. "Listen close. I want you to shoot them out. After that, run away. Get upwind of this place—"

"Major, my orders are to stick with you."

"I know, but those transformers are going to burn. The smoke is poisonous, and you don't have a gas mask. The smoke can't hurt me, though."

"Huh?"

"I don't breathe," Inga said. "Now, when help gets here, report at once to the RadSafe people for decontamination. Understood?"

"Yes. Major? Those maniacs have gas masks. The smoke won't hurt them."

"I know. I'm betting that they can't see through it. Let's go."

Alvarez drew his pistol, cocked it, and raised it. In one fluid motion he bounced into the open, aimed, and squeezed off several rounds. Then he leaped back to safety, just ahead of another volley from the shop. "Got it," he said.

Inga heard cracklings and poppings as the transformers caught fire. She looked around the corner and saw the first billows of greasy black smoke, roiling in the wind. "Get going," she told Alvarez, and was relieved to see him obey.

There was a loud roar as the transformers exploded and fell to the ground. Inga risked another look, and saw the dense smoke churning around the machine shop and spilling onto the street. Crouching, Inga limped into it, hurrying across the pavement. The interference grew stronger; too late, she wondered if it could overload her circuits.

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Inga stumbled forward, across the street and into the parking lot. Where was that damned cable? she wondered. If the smoke had blinded the terrorists, it had done the same to her. She didn't even know if she was moving in the right direction—

Inga's foot snagged something and she went sprawling, scraping her teflex-coated palms on the rough pavement, while bullets sprayed the air above her. Through the smoke she saw the detonator cable twisted around her ankle. Inga grabbed it with both hands and pulled. The cable held firm, and for one horrifying instant she thought she had activated a boobytrap. Then the cable went slack and she pulled it out of the hole, until she found herself clutching its end. Inga looked at the medusa tangle of blasting caps and wires, and then tossed it aside. Now it was time to run.

All at once the wind shifted, blowing away her smokescreen, exposing her. Inga looked at the shop's broken windows and waited to die.

Nothing happened, and after a long moment she lurched to her feet. Knowing what she would find, she staggered into the building.

Thick, oily smoke filled the shop. Inga found one man inside an office, sprawling dead on the floor. He wore an old military gas mask, but it hadn't been sealed correctly. That trivial mistake had killed him.

There was an assortment of electronic gear in the office, powered by batteries. Inga began flipping *off* switches, and the interference faded away.

Inga entered the shop area, and found two more dead terrorists. One of them was slumped next to a small control unit, and Inga realized that his last act had been to activate the bomb. While she looked at the unit, the blasting caps suddenly banged away, harmlessly.

I killed them, Inga thought, as she limped out of the machine shop. She hadn't meant to do that . . . but they had already killed two men, and they had tried to kill a lot more people, including her. That tempered her guilt. It's all over now, Inga told herself.

Then she saw the silver-blue ghost of the Moon, riding high in the daytime sky, and she realized it still wasn't over. She owed something to Janet Bedford, and there was no way to escape the debt.

13

"You make it sound like Sere beat itself," Janet said, when Inga had finished telling her story. The geologist slouched in a chair in her home, watching the other woman through heavily lidded eyes.

"In a way, they did," Inga said. "They didn't understand what they were doing. None of this could've happened if they *had* understood."

Janet nodded. "If they'd known any physics, they would have realized that reactor 'wastes' can still sustain a chain reaction, if you put them together in a critical mass. There've been accidents like this mess before in reprocessing plants and waste storage sites, when people got careless with spent fuel."

"I didn't mean that," Inga said, "but their ignorance did make it easier to find them. What I meant—well, they thought that science was part of some anti-human tyranny, something alien to human nature. But if they'd ever learned anything about science, they would have

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realized that science exists to fulfill human needs. Science itself is never dangerous—but people who misuse it are."

"That's obvious," Janet said, clasping her hands behind her head. "Why d'you suppose they couldn't see that?"

"I think I can explain it," Inga said uneasily. She caught herself squirming around in her chair, settling into a defensive posture. "They identified themselves as revolutionaries—and as nothing else. Without a 'cause' to fight for, their lives would become pointless, so they couldn't accept anything that contradicted their beliefs. They would rather have died first . . . and they did.

"Farrier had a similar problem," Inga went on. "I think he thought of himself as the finest cop who ever lived. The way *he* saw things, nobody was a tenth as competent as he was at fighting terrorists."

"And he thought you were a hindrance?" the geologist asked.

"He thought I was something worse," Inga said. "You see, there have always been some politicians who criticized him; that's to be expected—but Farrier's ego was too big to accept that. He saw any kind of criticism or outside interference as an attempt to sabotage his work, by people who sympathized with extremists, or by people who were playing politics. Farrier saw the world as a political jungle."

"Maybe he was right. I hear he was 'invited' to retire," Janet said.

Inga shook her head. "He wrecked his own career, because he spent too much time looking for non-existent conspiracies against himself. Farrier nearly bungled the fight against Sere—and there was no way for the President to ignore that. It's funny, but if Farrier could have admitted that he wasn't the Great G-Man, and cooperated with other people, he could have come out of this as a hero—but he couldn't change his beliefs any more than Sere could." Inga hesitated, and then added, "Or any more than I could."

"I don't see that," Janet said. She sat up, looking puzzled.

"Farrier was busy playing politics, and looking out for his career," Inga explained. "So why should he care if I was human or not? *That* couldn't matter to him—but I kept telling myself that he was reacting to me as a cyborg, instead of as a political problem. I—" She was glad that plastiflesh couldn't blush. "Well, I had my own fantasy-view of the world. Everyone had to think of me as a cyborg, and they had to have a definite opinion about what I am. It was stupid, and egotistical, and if I hadn't watched Farrier and Sere ruin their lives with *their* fantasies, I might still be locked into that cycle."

Janet frowned. "But how did you get into that fix in the first place?"

Here comes the hard part, Inga thought. It had been one thing when the cyborg had been an emotional cripple,

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but how would Janet react when she discovered that Inga was something other than human? "There was a conflict between my conscious and subconscious mind—or maybe between its organic and cybernetic parts. You see, consciously I did not want to be anything other than a normal human being."

"Who doesn't?" Janet asked. She rubbed her chin and added thoughtfully, "Nobody wants to feel like an outcast—but we all want to feel that we're something special, which isn't too different. D'you mean that your subconscious wanted to prove that you're a freak?"

"No! It had come to terms with what I am, and it definitely wanted to survive—which it couldn't do while I denied that I was a cyborg. The conflict was tearing me apart. My subconscious had to grab at anything that might make me face reality; that's why it compelled me to listen to anyone who would say I wasn't human—even idiots like Farrier."

Janet leaned forward in her chair. "And what is this 'reality'?"

"That I'm not entirely human." Inga got up and began pacing. The lunar gravity added a graceful springiness to her walk. "Janet, I told you why I can't dream. It's because my neuristor array analyzes all of my experiences as they happen, and integrates them into my personality."

"So you said."

"And you suggested that it makes me saner than most people. I don't know if *that's* true—but I've seen how it affects my emotional balance. Farrier kept insulting me, because he hoped I'd get mad enough to quit—but every time he hit me in a tender spot, something would squelch my anger as soon as I'd feel it. You see, I knew that I had an important job to perform. My subconscious killed any emotion that might have interfered with the task."

Inga stopped pacing, and gazed at a blown-glass sculpture on a shelf. "And when I found Sere—I told you that I used myself as a kind of radio detector. I got shot and I didn't even feel it. That smoke didn't even faze me. I worked for two days straight, with no rest, while other people wore out from the strain."

"Which no human being could have done," Janet said. "I suppose that made you feel superior?"

"No, nothing like that, but it did give me a sense of . . . fulfillment. It let me see that there were things that I can do as a cyborg—that I'm something more than an exalted cripple." Inga tried to choose her words carefully. If she misspoke herself, she knew that Janet would forgive her—but she wanted to avoid hurting her feelings in the first place. "But the most important thing I've learned is that my mind has some control over my emotions, instead of the other way around."

Janet's eyes narrowed to slits. "Does that mean that you're more human than the rest of us? Or are emotions something that you just indulge in when it suits you?"

"You know me better than that," Inga said gently. "Emotions can be logical. Without curiousity, why get out of bed in the morning? If you don't enjoy the world, what's the point in existing? Without love and friendship, why bother living?"

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"But are you sure you still aren't deluding yourself? How can you know?"

Inga looked at her friend. "Janet, there's something I could never understand before all this happened to me. I always thought that you pitied me instead of liking me—and I resented you for that."

"What made you think *that*?" Janet asked gruffly.

"I just couldn't grasp the idea that anyone could accept me as a person, or a friend, and not see me as a freak. Now I know better."

Janet was silent for a long time, before she got up and hugged Inga. "I'm not sure I understand," she said, letting her go, "But I want to try." Janet smiled wanly. "That's logical, isn't it?" ■

IN TIMES TO COME

Next month Stephen L. Burns (who wrote last year's Anlab-winning short story, "A Touch Beyond") has his first Analog cover, for his novelette "In the Kingdom at Morning." Even in the outer Solar System, some labor-management problems are likely to look very familiar, and what's done about them is likely to have at least a bit of a historically familiar ring to it. But in this case, at least, there are also elements quite unlike any historical precedent. The sheer scale and audacity of the operation, for one thing; and the very special role of one of the heroines, for another. . . .

Our February issue will offer Elizabeth Moon's "A Delicate Adjustment," a thought-provoking novella which I fully expect to generate some lively controversy. And G. Harry Stine's article "The Dream Is Down" examines what is *really* significant about the loss of space shuttle *Challenger*—and why the larger loss doesn't have to be permanent.

●Increasing knowledge of science without a corresponding growth of religious wisdom only increases our fear of death.

Sir Sarvepalli Radhakrishnan

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Probability Zero

LEFT TO

Robert L. Forward, a plump, cherubic physicist of Hughes Research Laboratories at Malibu, and occasional science fiction writer, was demonstrating the mechanism in his usual bright and articulate manner.

"As you see," he said, "we have here a large spinning ring, or doughnut, of particles compressed by an appropriate magnetic field. The particles are moving at 0.95 times the speed of light under conditions which, if I am correct, a change in parity can be induced in some object that passes through the hole of the doughnut."

"A change in parity?" I said. "You mean left and right will interchange?"

"*Something* will interchange. I'm not sure what. My own belief is that eventually, something like this will change particles into antiparticles and vice versa. This will be the way to obtain an indefinitely large supply of antimatter which can then be used to power the kind of ships that would make interstellar travel possible."

"Why not try it out?" I said. "Send a beam of protons through the hole."

"I've done that. Nothing happens. The doughnut is not powerful enough. But my mathematics tells me that the more organized the sample of matter, the more likely it is that an interchange, such as left to right, will take place. If I can show that such a change will take place on highly organized matter, I can obtain a grant that will enable me to greatly strengthen this device."

"Do you have something in mind as a test?"

"Absolutely," said Bob. "I have calculated that a human being is just sufficiently highly organized to undergo the transformation, so I'm going to pass through the doughnut hole myself."

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"You can't do that, Bob," I said [illegible]

"I can't ask anyone else to take the chance. It [illegible]

"But even if it succeeds, the apex of your heart will be pointed to the right, your liver will be on the left. Worse, all your amino acids will shift from L to D, and all your sugars from D to L. You will no longer be able to eat and digest."

"Nonsense," said Bob. "I'll just pass through a second time and then I'll be exactly as I was before."

And without further ado, he climbed a small ladder, balanced himself over the hole, and dropped through. He landed on a rubber mattress, and then crawled out from under the doughnut.

"How do you feel?" I asked anxiously.

"Obviously, I'm alive," he said.

"Yes, but how do you *feel*?"

"Perfectly normal," said Bob, seeming rather disappointed. "I feel exactly as I did before I jumped through."

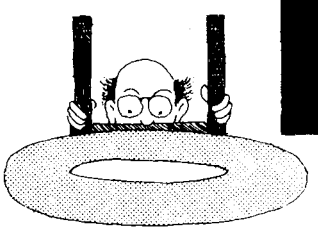
"Well, of course you would, but where is your heart?"

Bob placed his hand on his chest, felt around, then shook his head. "The heartbeat is on the left side, as usual. —Wait, let's check my appendicitis scar."

He did, then looked up savagely at me. "Right where it's supposed to be. Nothing happened. There goes all my chance at a grant."

I said hopefully, "Perhaps some other change took place."

"No." Bob's mercurial temperament had descended into gloom. "Nothing has changed. Nothing at all. I'm as sure of that as I'm sure that my name is Robert L. Backward." ■



RIGHT

Isaac Asimov

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The Alternate View

FRONTIERS AND WARS

G. Harry Stine

Today, we're obsessed with frontiers and wars. We desperately want to open a new frontier in space. Just as desperately, we wish to avoid a general thermonuclear war if possible.

It may be that the two are incompatible—i.e., that if we have one we will not have the other, or that the lack of one may unleash the energies necessary to achieve the other.

A great deal has been written and discussed about the need for opening the (new) (high) (far) (final) frontier of space. Various rationales have been impassionately argued for the expansion of human habitation into space.

At the same time, it's been widely perceived by many people—not all of them pacifists or left-wingers—that an invariant equation holds true: Militarization = War. This has led to the demand for the impossible: the demilitarization of outer space. It's impossible because (a) it's too late, and (b) the opening of the space frontier will probably eliminate the causes and even the need for a general thermonuclear war. (The fact that something like SDI could also make general thermonuclear war impossible or obsolete isn't a factor in this particular discussion, by the way.)

The 20th century has seen two general wars—World War I (1914–1918), and World War II (1939–1945). Some historians are beginning to consider the two as a single protracted conflict with a 21-year armistice separating two periods of fighting; as such, it would be the modern Thirty Years' War. Whether one or two wars, they were "general" wars which involved entire populations of continents, and this is the definition that will hold for this discussion.

Between the two general wars, a host of small, localized wars took place. But such localized wars aren't general wars. If you happen to be caught in one of them, however, it can seem just as devastating, disrrupting, and deadly as a general war—which it may be, but only on a local or regional basis because the rest of the world goes on "business as usual." There also have been hundreds of wars since 1945. The biggest are remembered worldwide while others are remembered locally because of their impact—Korea in 1950–1953, Southeast Asia from 20 November 1946 until today, the Arab-Israeli War from 15 May 1948 until today, plus such conflicts as Falkland-Malvinas, Iran-Iraq, Pakistan-India, Afghanistan, and the multitude of African wars.

In fact, small wars, guerrilla wars, insurgency wars, revolutionary wars, civil wars, and other small wars have gone on almost continually throughout history.

But in considering frontiers and wars, I'm going to ignore the "small" wars and use the term "war" to refer to general wars which, these days, appear as though they'll undoubtedly be nuclear in nature. The human race can probably live with small wars, but a general war

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would do enormous damage to world-wide civilization. (I'm not an advocate of the "no survivors" school; in a discussion about thermonuclear warfare, the late Dr. Willy Ley once remarked, "There will always be survivors.")

The human race can probably (nine-nines reliability with a nine-nines confidence level) avoid a general thermonuclear war by opening the frontier of space. On the other hand, the probabilities are the same if one considers that a thermonuclear general war will probably prevent us from going into space.

This has been intimated many times. But no one to my knowledge has pointed out the historical justification for the statement. (Yes, I know that history doesn't repeat itself, but the patterns of history may.)

One doesn't have to look back very far to find the historical analog. And, since the analog occurred relatively recently, the pattern probably hasn't changed radically since.

The European century between the abdication of Napoleon in 1815 and the assassination of Austrian Archduke Franz Ferdinand and his wife at Sarajevo in 1914 was a hundred years of almost miraculous tranquility. Although about a half-dozen sizable conflicts occurred in Europe, none was protracted, very costly in life, or destructive to entire nations or peoples. The inhabitants of Amsterdam in July 1866 hardly knew of the Seven Weeks' War. Between 1885 and 1910, there were no wars in Europe and almost no boundary changes. The ideal of 19th century liberalism was "peaceful progress," which, by definition, precludes war. Peace had become a habit of mind and a condition of life. Peace was expected to persist regardless of the increasing sums spent on armament every year.

Why?

Hypothesis: Special conditions restrained the major powers from waging general war. Most important was the enormous expansion in the availability of resources. For the first time in human history, people were relieved of the constant fear of famine, privation, and a constant tomorrow which would be no better than today. Although we hear much about the hardships suffered by the factory workers during the early years of the First Industrial Revolution, we forget that manufacturing provides year-round work and a steady demand for agricultural products. The common man also had an escape from the consequences of staying at home: the open door of migration to exploit the new lands of America and Australia.

In short, Europeans had a frontier.

Maybe the 19th century should be called "the century of the common man," because during that period really revolutionary changes occurred in living conditions and expectations.

Quarrels between neighboring nations took second priority to frontier imperialism. For Great Britain, France, and the Russian Empire, the attractions and rewards of the frontier drew their military efforts away from Europe. The growth of the British Empire during this period is well known. During the same period, France established an enormous colonial empire in Africa as well as in the Far East. Russian pioneers carried Czarist power eastward to the shores of the Pacific and then attempted to turn south to establish control over the Mus-

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lim kingdoms and khanates of central Asia (an effort still being carried on by the Soviet Union in places such as Afghanistan).

Thus, the European nations with the greatest warmaking potential were far too busy on their frontiers and had very little energy to waste and few motives to engage in struggles within the European heartland. Furthermore, they were on the periphery of Europe and could easily look outward.

Why did this all come apart in 1914?

Two central European nations without colonial frontiers took advantage of Britain, France, and Russia's preoccupation with their respective frontiers.

The Dual Monarchy of Austria-Hungary was sick by 1900. Although it had internal natural resources as well as a growing technological and industrial might (the Austrian and Czech engineers were and still are sharp), it was a diverse collection of unassimilated German-speaking Austrians and Germans as well as Hungarians and Slavic-speaking Czechs, Slovaks, Poles, Croats, Slovenes, and Serbians. The Dual Monarchy was no melting pot like the United States. It had no frontier to provide the heat for melting.

By 1871, Germany had ceased to be a cluster of small kingdoms, principalities, and duchies and had become the German Empire. By the time this happened, the early edge of the First Industrial Revolution had worn off. Germany found that cheap resources were hard to come by, easy markets difficult to find, and all of the good overseas colonial frontiers already taken by Britain and France. The Germans largely overcame these adversities through their inventiveness, energy, and discipline. Germany became an industrial giant because of these factors. But Germany had no accessible frontier outside of Europe. The disparity between her enormous economic power and her meager overseas possessions was a constant source of national discontent. This was exacerbated by the tendency of the frontier powers—Britain, France, and Russia—to treat Germany as the new kid on the block and exclude the Germans from as much international diplomatic and economic action as possible. The German Kaiser therefore began to indulge in unnecessary state investments. The Germans could see what naval power had done for Britain's frontier expansion, so the Kaiser built an enormous High Seas Fleet which, by 1914, was almost large enough to take on the Brits. Being a European land power, Germany also built up an enormously efficient army.

Add the elements of discontent, ambition, economic power, and military strength to the fact that there was no German frontier to absorb these energies. It took only one minor incident to create a break in the dam restraining these energies. Having no frontier, Germany set out to create one for herself in Europe, but the full realization of what the Germans were up to didn't dawn on the rest of the world until Adolf Hitler went after *Lebensraum* in Eastern Europe and the steppes of Central Asia. Since this region was already full of people, the Germans had to eliminate them, which they tried but failed to accomplish.

I believe a modern object lesson can be gained from this historical summary:

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The physical frontiers of Planet Earth no longer exist. Yet the world is still full of ambitious, discontented, powerful, disciplined, inventive, and militant people among whom are the Americans, the Soviets, the Chinese, the Japanese, the Brazilians, and the Indians. (America isn't a militant culture, you say? Is there a small town whose high school doesn't have a marching band?) These peoples need the physical frontier of space and they need it soon. Otherwise, they'll likely be at one another's throats in a general war which none of them really wants but which will be triggered by an incident none of them will able to ignore. And we don't know what that incident will be. . . .

If that incident occurs before the frontier is open, the consequences could be so devastating that the space frontier may not be opened for a thousand years, if ever.

And then we're in trouble because we're trapped on this small planet with all the future scenarios of our historical analogy.

The space frontier: Move to it or lose it, folks . . . lose it along with everything else you've got. And we haven't got time to argue about it. ■

ON GAMING

(continued from page 111)

toward the planet. A letter "S" lights up when you are in the vicinity of the space station, and then one can only hope that you have practiced docking enough.

Eventually you get into combat and that's when I knew this was a great game.

As you use the movement controls to target your lasers and missiles, you feel like baby trying to pilot an F-15. Just about anybody you meet is going to fly circles around you. But it's a thrilling (if short lived) experience since your ship responds much as you imagine a real one would.

And as you get blown away, you vow to master its intricacies. After all, you learned how to drive, didn't you?

The game also makes allowances for people who make career decisions that stray from the straight and narrow. Some alternatives provided are Bounty Hunter (galactic banks pay plenty for destroyed pirates), Piracy (see above), Asteroid Mining (but you'll need a Minreduc-15 mining laser), and Illegal Trading (in such items as firearms, narcotics, and humanoid slaves).

The rule book includes a witty political profile of the universe, and a description of the alien races you may meet. A colorful chart shows the outline of all the ships you may possibly face.

Some may find the line graphics of the ships and space stations a bit spartan, but it's more than made up by the sheer imaginative scope of this game.

Originally produced in the United Kingdom, *Elite* is a remarkable game. ■

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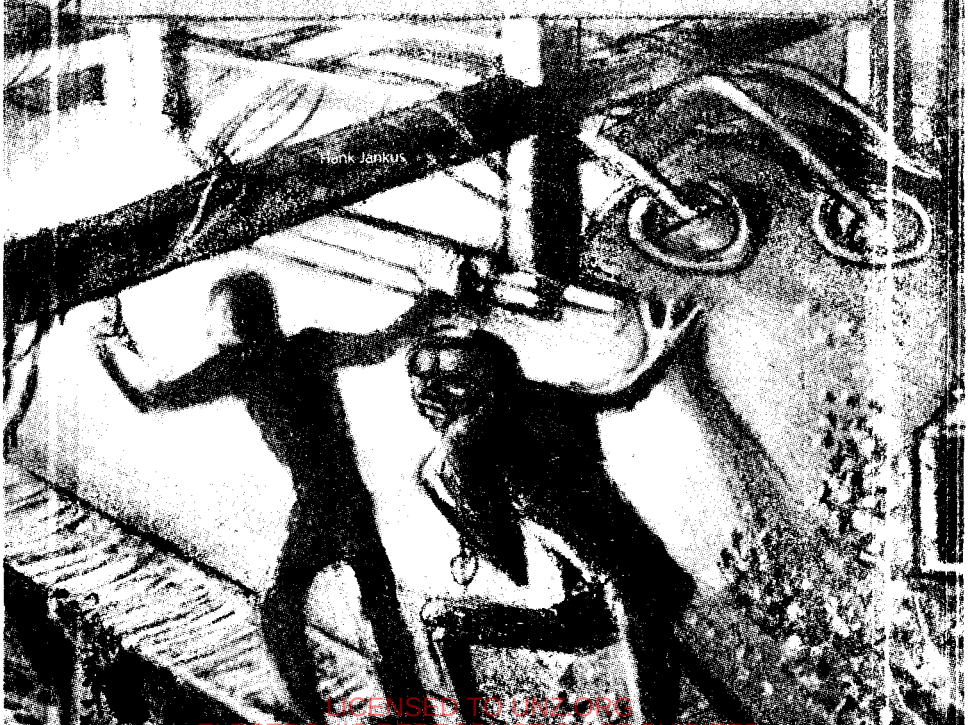
Ian Stewart

BILLY THE KID

We all know the early years of Great Lives can be full of inspiration. . . .

Hank Jankus



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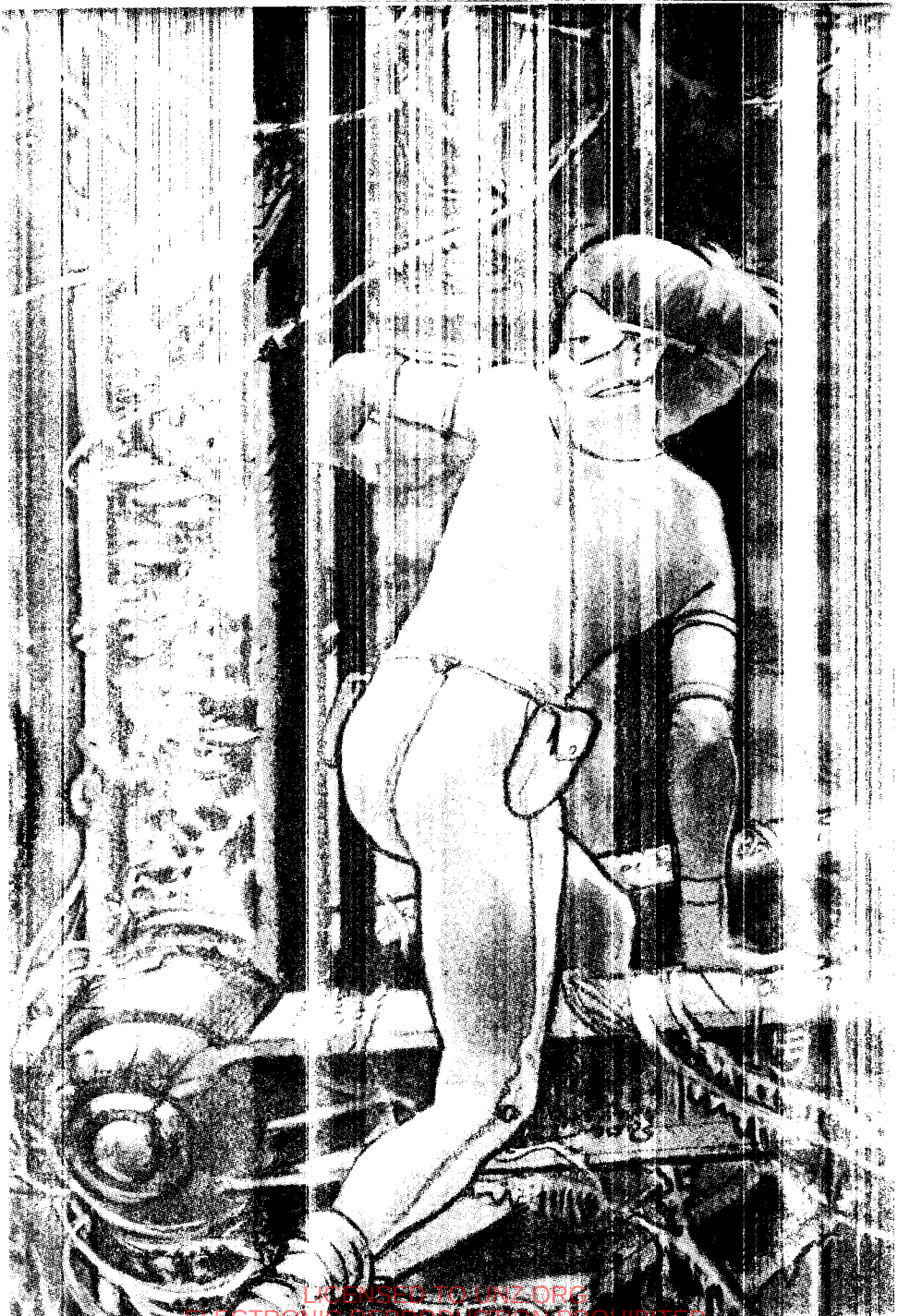

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Stock holovix library tape: spaceview of planet Wyldhype, green marble splashed with white . . . compuzoom infinity-zero: snowbound continents / Fyffe Island / dramarama City lights / WHBS Tower in snowstorm / Crow's-Nest Studio / snow-covered observation deck / vuframe cutout / studio interior . . . Camera B splitscreen slidepan from opening creds to studioset right . . . rollup holovix camera D to main podium . . . intercut sponsorlogo with title graphix . . . fade theme, overlay narrator.

Narrator—Good evening ladies and gentlemen, Grynths and Grynneths, Barasshanti of all persuasions, and Femm. Welcome to the four hundred and eighty-first transmission of *In Sector Tonight*, anchored by the sapients' soulmate . . . ALVYN SYLVESTER SNERGRUDE!

Thunderous applause, stamping hooves, anticipatory husks, and sundry stridulations, wauls, and whiffles.

Alvyn S. Snergrude—Thank you, thank you one and all. And on *In Sector Tonight* tonight we have the Minister for Disparagement from Wemyss Beta, a team of lady shovel-swallowers from Brunhilde IV, a Grynth inventor from Port Psyclops with an entirely new design of spore-timer, and the hoom who put wings on the pigs of Ankershou. My first guest, the pig-man: *Billy the Joat!*

Enter W. Jarneyvore, clad in lime green skew-cut tightsuit with a yellow cummerbund and a large cowbane blossom in his right elbow frill.

Applause.

ASS—Welcome to *In Sector Tonight*, Billy.

BtJ—Most kind, thanks Alvyn. Hi folks. [*Sits.*]

ASS—Now, just in case there are a few of our fourteen trillion holoviewers out there who didn't catch yesterday's flashfax, could you explain what a Joat is?

BtJ—Jack-Of-All-Trades. I'm the self-taught equivalent of a Laterodox Polymath.

ASS—And what gave you the idea of bringing winged pigs to court to bolster the case against Femm exploitation of Ankershou?

BtJ—Well, it just seemed to me the situation was crying out for a writ of *habeas porcus*, so I writ one. [*Laughter.*]

ASS—And what made you decide to become a Joat, Billy?

BtJ—I suppose . . . it all got started around my eleventh birthday. I was just an ordinary kid at Grover High. . . .

"Billy! Billllllllyyyyyyyyy! Tarnish it, where *is* the child? Wyllam!"

"Yes, Moom?"

Terpsichore Jarveyvore wiped her brow with the clenzall and sighed. "*There* you are. And *covered* in mud as usual. It's time for school, Billy! Hose down that slicksuit and get yourself over to the landing-stage for the school tove *at once*."

"Yes, Moom."

"Don't you 'yes, Moom' me, you cheeky little troon."

"No, Moom." Billy sauntered slowly down to the tovestop, his school bag slung nonchalantly over one shoulder, and joined the twenty or so kids from Raft 4177 just as the battered old tove, pale blue streaked with orange mud, sloshed to a halt at the mooring post.

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The chattering rabble clambered aboard, to sour looks from the browning Grynth pilot. The tove cast off and lumbered across the mudflats in a cloud of steam.

Grover's World was one huge mudball. Its glutinuous orange swamps covered the entire surface. The swamp varied in depth from fifty feet to several thousand, a mud ocean with no land. The ocean swarmed with living creatures—wollagongs, mudlarks, swampskeeters, mudslingers, slobbers, boggies, shronk, and quagmoles. There were tangled growths of squelp and oozing sponge, and colonies of quolyp flourished on any semi-solid object floating on the surface. The people of Grover's World lived on loosely knit assemblages of huge rafts, supported by massive flotation chambers shaped like blunt sausages. To dissuade the quolyp, these were periodically partially deflated and inflated. This slow rhythmic pulsation deformed the shape of the chamber, breaking off the incrustation before it could gain a proper hold.

Why should any one in his right mind choose to live on Grover's World?

Because of the mud.

It was a planet-wide breeding ground for microorganisms, acting as a vast renewable source of organic macromolecular feedstock. Thousands of companies, large and small, had descended on it to reap their profits from the teeming mire. And with them came the family Jarneyvore.

Although Billy would never admit it in front of his classmates, there were times when he actually *liked* school. The elementary solitronics course was his favorite, and he was well into building a Bell System Scrambler. True, the teacher thought it was a mail scheduler, but Billy had replaced the sealed RNA biochip with a home-made one, custom-cultured in his mother's vitrovarium. When he finished it, the phone company was going to get a surprise. . . .

He also liked languages (he was fluent in Erbish, Divotte, and Haphza, as well as the usual Merkan and Platt-deutsch, Grynth standard, pidgin Barasshanti and a smattering of Femmish), radiation technology, mathematics, quag chemistry, and cybergenetics. His perfect memory helped, though he deliberately made mistakes to conceal it, to avoid attracting attention—the other kids would have made life a Sump for him if they'd thought he was cleverer than they were. He had a quick intelligence and his breadth was remarkable.

He was also a pain in the fundamentals.

And, that morning, in deep trouble.

It began as soon as he got off the tove. The swimnastics coach was waiting for him. "Jarneyvore! Go to the Principal's Office! At once!"

"Yes, sir. What for, sir?"

"You'll find out. Go!"

Billy went. Along the way he discarded several sensitive items from his schoolbag and concealed them in a hole behind the main drainage channel, transferring several others to a secret pocket in his codpiece. It was best to be prepared.

The Principal, Maloysius Long, was a man harboring a grudge. His family was active in Grover's World commerce—his sister Wylgeta owned LPC, a polymer-producing corporation with outlets on a dozen worlds. Maloysius Long played no part in this—Wylgeta

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had inherited the lot when their father died, and Maloysius hated her for it. The fact that she had a flair for business, whereas Maloysius was too unimaginative—and the strong suspicion that the father had seen this clearly and based his decision on it—only made matters worse.

Maloysius Long was also unshakably strait-laced and could not abide independent minds. Certainly not if they undermined his authority. Unfortunately young Billy Jarneyvore managed to combine all the orthodox forms of unorthodoxy with a few unorthodox forms of his own, and his instinctive reaction to authority was to flout it. The two saw eyeball to eyeball rather than eye to eye. There was only one person on Grover's World whom Billy disliked more, and that was Mayor Graspmudgeon. Billy knew that Graspmudgeon was taking bribes from construction companies. He couldn't tell anybody because he had found out by tapping Graspmudgeon's private phone line, which was strictly illegal.

Billy had a suspicion what the subject of discussion would be. The previous night he had been skulking around the substructure of Long's dwelling place, which was on the same raft as the high school, looking for a suitable place to infect the floorboards with a virulent strain of dendrophage. He had just located a perfect spot when the floor opened (prematurely, he felt) above his head, knocking him from his perch into the mud twenty feet below. Billy, catching a quick glimpse of a trap door and a head in silhouette, lay flat in the mud pretending to be a dead wollagong pup. The head disappeared, but there were confused shouts from within the building, so Billy crawled off between the understruts. Shortly afterward, someone had shone a torch through the trap door. At the time Billy thought he hadn't been spotted; but apparently Old Longjohns had recognized him. Or maybe he just guessed it was Billy, which was a natural enough deduction given the history of their relationship.

He reached the principal's office, hesitated, swallowed, and knocked on the door. Long's disagreeable voice bade him enter. He did.

"Oh, it's you." Leathery jowled face, like a desiccated bloodhound. "So what have you got to say for yourself?"

"Me, sir? What about, sir?"

Long shot him a sour glance. "Don't try to pull the mud over my gills, Jarneyvore! This time you're gone too far! I'm suspending you pending an investigation by the Constabulary."

"But I haven't done anything!" said Billy indignantly. *Nothing you can prove, anyway*. But he wondered why Old Longjohns was getting so snorty around the orifices about a harmless prank. He'd never been threatened with the phoz before.

"*Someone* did," said Long flatly. "Someone who knew how to break computer security codes. Someone who knew how to tap into the datastream of Grover's Luticultural Bank. There is only one person in this school with that kind of ability, and that is *you*. Admit it!"

A number of thoughts flashed into Billy's mind. The first was that he had no idea what Long was talking about. The second was that Long's behavior did not quite ring true—there was an

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awkwardness to his speech-patterns, as if he was acting out a prepared script. The third was that there was a large phozbug poorly concealed behind a pot of cydrangulas on Long's desk. Clearly Long's prepared speech was for its benefit. All of which meant that he was being set up for something he didn't do. . . . But *why?*

"Admit what?" he said, trying to gain time.

"That you embezzled the school charity fund. You're a thief, Jarneyvore." Long waved a sheaf of holofax printouts. "And I've got the evidence to prove it."

Billy's control slipped, allowing a look of horror to appear on his face. He liked his fun, certainly. But he was, in his own way, honest. The charity fund for handicapped Barasshanti younglings was something that he would *never* tamper with. Hadn't he organized the sponsored wallow-in on its behalf? Long's evidence must be faked. Why was Long going to such lengths over a practical joke, when he could get Billy into plenty of trouble just by telling the truth? It didn't make sense. As Billy began to deny responsibility for the theft it dawned on him that his charitable action could easily be viewed as a ploy to bolster the size of the fund before plundering it.

It also dawned on him that the phozbug must have been in real-time surveillance mode, when the door opened to reveal two uniformed constables. "This is the culprit, officers. You can take him away."

The constables advanced into the room. Billy began to cry. He fumbled in the waistband of his slicksuit and drew out a moderately clean handkerchief. He wiped his eyes, blew his nose loudly, then burst into tears again and dropped the handkerchief on the floor. He dredged another from his waist-pouch. Long was taken aback. He'd never seen Billy Jarneyvore shed a tear in his life. Come to think of it. . . .

There was a bright purple flash and a noise like a thunderclap as the moisture-sensitive chemicals impregnating the first handkerchief reacted. The room vanished in a pall of gray smoke. Billy pulled the second handkerchief—actually a thin-film filter—over his nose and crawled along the wall to the door. He opened it noiselessly and crept out into the hallway. Leaping to his feet he set off down the corridor at a fast trot. If Long was trying to frame him he wasn't going to hang around and argue the merits of the case: he was going to keep his freedom and use it to find out what on Grover's World was behind it all.

From behind came coughs, and cries of "Stop him! Stop that boy!"

The astropology mistress barred his way. Billy plugged his ears with chewing-gum and activated a shrieker capsule disguised as a fastener on his kneepouch. As the keening howl filled the building the teacher fell to the floor, moaning and holding her head. Billy jumped over her, shot down the stairs, hit the main concourse at a run heading for the refectory balcony. Two more shriekers cleared the way. His back foot launched him on to a dining bench, his front foot hit the balcony rail, and he dropped thirty feet to the swamp. With a resounding splat he hit, and disappeared from view.

His pursuers looked down from the

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balcony rail, stunned. A single semicircular shockwave rippled across the mire, upsetting basking mudlarks as it passed. Their puzzled hoots could be heard faintly, disappearing into the distance.

The crowd on the balcony stared in growing horror at the mud. Nothing disturbed its surface.

ASS—But you didn't drown, did you?

BtJ—A perceptive remark, Alvyn. No. I lay in the mud for a while, breathing through a simugill I happened to be carrying with me. Then, before the search teams arrived, I removed myself from the scene and hid among the struts underneath the raft.

ASS—You seem to have spent a lot of your time underneath rafts.

BtJ—Yes, I did, actually. That's why I was always coming home muddy. Moom thought I was hunting for mudlark-eggs in sumpholes, like the other kids sometimes did.

ASS—And what happened then?

Billy had had plenty of time to think things through while lying immobile in the mud. "After you have eliminated the impossible," as his holovix heroine Shirley Combs was wont to say, "whatever remains, however improbable, must be the truth." Blatant nonsense really, because you could never be absolutely certain that what you thought was impossible really was. But a reasonable punt position . . . *Something* has triggered a series of inexplicable acts on the part of Principal Maloysius Long. Apart from the incident beneath the floorboards, Billy had done nothing likely to have that effect for several weeks. (He'd been laying off harassing Long in the hope that he wouldn't be suspected when that personage's floor fell in.) Ergo: Long *had* recognized him under the floor.

So why had he invented a quag-and-mudball story about the charity fund? And gone to the trouble of faking holofax printouts as evidence? Come to think of it, Old Longjohns could hack a computer about as well as a wollagong could hang-glide. Hypothesis 1: Long had hired someone to produce the fakes. That would be expensive. And dangerously insecure—Long could lose his job if the facts ever came to light. Ridiculous. Hypothesis 2: Somebody else had done it for Long. Same problem. Hmmmm.

Billy blew a small bubble and looked through it at his watch: three minutes. Not time to move yet. Back to the brainwork. It couldn't have been Long, therefore someone else *must* have been involved. Billy cast his mind back to the previous night. The trapdoor opened, a head in silhouette . . . was it Long? He visualized the scene. The head seemed broader, the neck more stumpy . . . confused shouting . . . how did it go? Something like *wallop my grandma with a featherless hippo* . . . That was idiotic. All hippos are featherless. . . .

Woullomig! Ranmurr taf edrellyss xsiphphou! Femmish for "Look out! There's somebody down there!" Why did Long have a Femm in his house? Because he and the Femm were up to some skulduggery! And when they'd seen Billy under the floor they'd panicked in case he dugged up a few awkward skuls. So they had to fix it so that

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nobody would believe a word Billy said, before the kid blew the whistle on the deal.

When it comes to getting results, the subconscious is a wondrous creation. It doesn't so much jump to conclusions as launch itself at them from a cannon. Long was involved in an illicit deal with the Femm.

But what the Sump was it that they thought Billy had *seen?* He reviewed the scene in his mind. Mud below, boards above. A standard inspection trap for underpinnings. The usual network of struts and flotation chambers. A rectangle of light picking out puddles of water amid the orange quagmire . . .

Nothing unusual there.

The *presence* of a Femm in Long's house? Curious, but not enough to excite comment . . . could have been a visiting Quaternity Educationalist, for instance . . .

But there must have been something. . . .

"Is there any other point to which you would wish to draw my attention?"

"To the curious incident of the shronk in the night-time."

"The shronk did nothing in the night-time."

"That was the curious incident," remarked Shirley Combs. Of course!

A "live" flotation chamber exhibits slow, rhythmic breathing, to discourage incrustation by quolyp. But the flotation chamber beneath Long's house was dead.

An inspection is in order, thought Billy.

He waited until dusk. Then he made his way to a nearby dock and borrowed a pair of skoats—ski-like flotation boots enabling their user to walk on the glutinous mud with the aid of two poles, each ending in a hollow sphere the size of a large wallowmelon. He skoated under the raft until he neared Long's dwelling. Then he removed the skoats, lodging them temporarily at the junction of several cross-struts, and cautiously made his way toward the flotation chamber, crawling along the main beams just below the flooring.

Definitely dead. Curious indeed.

He arranged himself in the most comfortable position he could find, and settled down to wait. The mournful honks of mudlarks lamenting the setting sun died away. From afar came the sepulchral drone of a cow wollagong calling her offspring. Night fell on Grover's World. From his boot Billy took a soft plastic mask with nitesite lenses, and pulled it over his eyes. Several hours passed.

It was the creaking of boards above his head that first alerted him. He watched as the trapdoor opened and someone shone a torch in a wide sweep. But he had chosen his position carefully and he couldn't be seen. Then a shadowy shape clambered through the opening, followed shortly by another. Long and his Femm companion. They made their way along the inspection catwalk to the flotation chamber. There was a pause while Long produced a small object—probably a magstripe card—and inserted it somewhere. Then they disappeared.

Billy wasn't totally surprised—he had guessed as much already. They had gone *inside* the chamber. Normally that wasn't possible: faulty chambers were deflated and detached for repair. They

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must have cut an opening, which explained why the chamber wasn't going through its pulsation cycle. And they had done something to make the chamber look as if it were still inflated . . . Maybe a chemical rigidifier. That argued careful planning. But for what?

Billy crept closer. He pressed an ear to the taut skin of the chamber, and confirmed his belief that it would make an effective sounding-board. He could hear every word from within.

". . . improvement," said Long.

"Yes. The new strain is crowing sugcessfully." *That was the Femm. The accent was unmistakable.* "And its degenerative properties have ingreased by one hundred and sigsty percent."

"Is it ready yet?" asked Long.

"Soon, soon . . . we must be certain that it will geep crowing in the natural egology."

"Right. But it must only affect the strains of bacteria used by LPC. I don't want a planet-wide disaster!"

"Of gorse," said the Femm. "That was all decided lonk ako. Yes . . . a high destrugtive fagtor is indigated. By tomorrow we will know whether it gan be sustained."

"Tomorrow! Ah, then I'll have them right where I want them! Wylgeta will regret the day she inherited the Long Polymer Chain!"

"Be galm, and wait. Tomorrow, if all koes as egspegted, you may release the orcanisms. But be gareful."

"Don't worry," said Long. "I've waited a long time for this. I'll be as cautious as a boggie in a shronk-midden."

It sounded as if the conversation was coming to an end. Billy retreated among the girders, just in time. Long and the mysterious Femm emerged from the flotation chamber and climbed back into the dwelling above.

You didn't have to be a genius to grasp the general idea. The Femm had supplied Long with some destructive organism—probably a tailored virus—intended to disrupt the activities of the Long Polymer Chain. Presumably by damaging the microorganisms that produced its feedstock. But why would the Femm involve themselves in Long's personal vendetta? The short answer was that they wouldn't . . . unless there was something in it for them. Everyone knew that the Femm only joined the Quaternity because the combined weight of Human, Grynth, and Barrasshanti was just that bit too much for them. They weren't willing partners, and they spent most of their time hatching plots to break up the alliance. Every little bit of sabotage helped. Divide and conquer, an old trick and one of the best in the book.

The Femm had led Long to believe the virus would only damage the activities of the Long Polymer Chain. Clearly this was a lie—the damage would be much more widespread. The entire economy of Grover's World was at risk. Why use Long at all? Because the Quaternity authorities would have little trouble reconstructing what had happened, and a non-Femm scapegoat was essential. Long was too consumed by hatred to realize this—or to realize that he was a pawn in a bigger game.

Billy had to get into that chamber. But Long had used a magstripe card, which meant that there was a heat-sensitive alarm. Billy could disconnect the

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alarm—if he could get inside. He could get inside—if he could disconnect the alarm. A pretty puzzle.

How does a boggie evade a pack of odor-sensitive shronk? It camouflages its odor in a pongonia patch. How does a burglar evade a heat-sensitive alarm? He camouflages his body heat.

Time for a trip to the school laboratory.

An hour later Billy had bypassed the school's locks and appropriated an assortment of equipment. Tools, solitronic components, a reel of wire, a flask of liquid nitrogen, a pump, a jar of chemicals, and assorted hoses and pipes. And, in a cage, the school's pet mudlark, affectionately known as Oozak.

ASS—Why steal the school pet?

BtJ—I thought I might need it. I was right, as you'll see. But it wasn't theft.

ASS—No?

BtJ—It was murder. . . .

Billy returned to the flotation chamber.

With the tools he cut a circular groove in the chamber's plastoid skin, not quite penetrating it. He rigged the pump and liquid nitrogen to produce a small snowstorm, and sat under it until he was worried that the chattering of his teeth would alert Maloysius Long. Then he kicked in the circle of plastoid, climbed through, and disabled the alarm before he could warm up enough to set it off.

He replaced the plastoid disk, taped it in position, and switched on the light.

The chamber had been rigged up as a makeshift workshop. There was a lot of expensive equipment, not all of which Billy recognized. In the middle was a sealed canister marked "Viral Containment Unit. DANGER!! DO NOT OPEN!!"

The viral chamber was connected by tubes to a sealed glass dish. Inside the dish was a layer of culture medium. A few greenish blotches with red centers dotted the surface—dead or dying bacteria. In this way the Femm had proved to Long that the virus would help him ruin LPC.

But presumably, somewhere else in the chamber . . . Billy began to search. Yes, there it was, fully visible on a shelf amid a heap of other equipment. . . .

A second dish.

But this one was covered in ugly yellow blotches—clusters of *living* bacteria. The dish was connected to a flask, to collect a liquid that the organisms were producing.

Carefully Billy ran off some of the liquid into a syringe. He looked at the caged mudlark. *Damn. Sorry, Oozak old friend. Grover's World needs a volunteer for a suicide mission, and you're elected unanimously by circumstances beyond my control.* He injected the liquid into the creature's neck-vein. If he was right, it wouldn't take long.

The ecology of Grover's World—as Miz Prigg was wont to emphasize in her Grovography class—was a single complex network of cause and effect. Feedback or be fedback. The unicellular microorganisms provided food for swamp-skeeters and crustacea which in turn fed the mudlarks and wollagongs, boggies and shronk. The waste products of the higher animals in turn nourished the microorganisms.

Break the chain at any point and the

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whole cycle dies. And the weakest link was the mudlarks.

Twenty minutes. Oozak continued to snuffle around his cage, rooting out swamp-skeeter larvae. But it didn't sound quite right. The snuffles were becoming labored. . . .

The mudlark was clearly in trouble. It rolled on to its side, convulsed twice, then was still.

ASS—So that's what you meant by "murder." You *expected* the creature to die.

BtJ—Yes.

ASS—That was pretty callous. Didn't you feel it was wrong to risk an innocent animal's life?

BtJ—I was trying to balance two wrongs, both involving innocents. I chose what I thought was the lesser of two evils.

ASS—That's rather a cold-blooded attitude.

BtJ—Do you know what happens when a planet's livelihood is destroyed, Mr. Snergrude? Suicides alone would cause the death of hundreds. I didn't ask to make that kind of choice. Just by doing nothing, I'd have chosen anyway. But I hated a system that put me in that position. And I vowed never to allow an animal to be harmed again if I could do anything about it. If you take a look at my career, you'll find I've succeeded, most of the time.

ASS—Anyway, the mudlark died, so your suspicions were confirmed. . . .

The Femm had tailored a virus. It was a masterly achievement. It did two things simultaneously. First, it killed the species of bacteria used by LPC. But that was just a blind. Its main job was to kill mudlarks, which it did by persuading another species of bacteria to produce a chemical that poisoned the creatures. The Femm would have chosen a species of bacteria that was common all over Grover's World. Now they had their virus, and were using Long's hatred for his sister as a vehicle to distribute it. Come daybreak, and Long would know that "his" virus was working. By midday he would have released it. He would have no idea what his actions would lead to. . . .

Billy could go to the Constabulary . . . no. They'd think it was a prank. By the time he convinced them it wasn't, it would be too late.

He could steal the virus. But Long would just breed more.

An idea came. Something he'd read about in Holovix Weekly.

He set to work. An hour passed. The task completed, he emerged through the hole in the plastoid. A quick coat of polysolv and nobody would ever know he had been there.

ASS—So when you broke into the school to get equipment you'd *already* worked out that the Femm were trying to poison mudlarks?

BtJ—Yes.

ASS—That's incredible! The chain of reasoning was so complicated!

BtJ—There wasn't any chain of reasoning. The idea made sense, but nothing else did. It was obvious.

ASS—To a budding Joat.

BtJ—I guess. The trick is to see the whole picture at once. A lot of things have always seemed obvious to me that

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most other people find impossible to understand.

ASS—Mmmph. So then what happened?

BtJ—I spent a sleepless night setting everything up. . . .

Nyjel Grawlvyre, Chief Constable of Grover's World, had a big job on his hands. Today was the opening of the new spaceport, and it was his task to provide security for several dozen visiting dignitaries, the most prominent being the Seventh Assistant Sub-Undersecretary for Transportation from the Sector Directorate on Aphélix. He had been working like a squabber all morning making final checks. Now the ceremonies were about to start. He sat in front of a bank of holovix monitors, trying simultaneously to watch raftboard approaches, airspace, and the ceremony itself.

Mayor Graspmudgeon was grasping hooves with a delegate from Tacktongle IV when Grawlvyre became aware that something unexpected was happening. On the giant replay board set up by GWHV (the local holovix franchisee) to give spectators a close-up view of the laying of the foundation-plank, there appeared a series of flash messages:

THIS IS AN EMERGENCY INTERRUPTION
WHAT IS THIS MAN DOING?
LISTEN. . . .

Grawlvyre gaped in astonishment as he saw, in slightly fuzzy close-up, the bloodhound features of the school principal Maloysius Long. He was with a Femm. Grawlvyre turned up the sound.

". . . Ready?"

"Yes. You may proceed!"

"I'll release the virus," said Long, lifting a large canister and tipping it on end. Fluid gushed out. "I've done it! I've broken the Long Polymer Chain! I've got that bitch Wylgeta at last!" He broke into a curious little dance.

Grawlvyre had no idea how the transmission had occurred, but the word "virus" tripped his relays and he knew that his job might depend on taking it seriously. He grabbed a communicator and began bellowing into it.

ASS—You'd rigged an HV camera?

BtJ—That's right. With a direct tap into the network and a remote so that I could keep track of what was happening.

ASS—But the virus was released anyway?

BtJ—I substituted a harmless liquid. I hid the virus to produce in evidence later.

ASS—And Long and his accomplice were arrested.

BtJ—Long was. The Femm has vanished.

ASS—Were you disappointed at that?

BtJ—Not really. I'd expected it. The Femm are too clever to hang around and get caught.

ASS—How did you feel when it was all over?

BtJ—Tired. And scared. I was worried what my mother would say. But I got a Sump of a kick out of it, too. It was the first time I'd really been able to *combine* all the things I was good at.

ASS—So that's when you decided to become a Joat?

BtJ—You don't *become* a Joat. You just realize that you *are* one. It's a state of mind, not a profession. But you're right. That was when the seeds were sown.

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ASS—What was your parents' reaction?

BtJ—My mother walloped me and then burst into tears. After I'd explained where I'd been, and why, my father said that I'd saved Grover's World from disaster, single-handed. Then *he* walloped me for not coming to ask for help. Then he told me he was proud of me. They were a bit confused.

ASS—It must have earned you a lot of recognition?

BtJ—Well . . . in a way . . .

The school hall was packed. At the podium stood the Mayor. He had been speaking for over an hour. Behind him, threescore local bigwigs, all Graspmudgeon appointees, all as corrupt as he was. On a seat to one side, a bored Wyllam Jarneyvore.

". . . And it is a tribute," Graspmudgeon droned on, "to the educational expertise of this administration, and to all of its officials, that this young man"—he acknowledged Billy's existence for the first time in his speech—"was afforded the opportunity to develop his unusual talents. Our enlightened approach to education has paid handsome dividends. . . ." *Indeed it has*, thought Billy. *Mostly in diverted Q funds going to your private account with the Nomes.* He smiled shyly. *Plus, I object to the way you try to take the credit for my efforts.*

"And now I shall call upon young Wyllam Jarneyvore to step up to the podium and receive this citation to honor his sterling work on behalf of the community."

Billy rose, still smiling. *Big fat hairy deal. I save the planet's economy and you give me a piece of paper and a pat on the back. And you act as if what I did only counts if it has your approval.*

Billy bowed stiffly as he took the beribboned scroll from Graspmudgeon's plump hand. "Thank you, your worship," he said politely. He stepped back. *Any time now,* he thought. There was a faint creaking sound and he stepped back further, trying to move at a natural pace.

The creaking became louder. The Mayor and his assembled toadies gave each other puzzled looks. With a crack, the floor beneath them sagged. They slid together in a tangled, screeching heap as it collapsed, dumping them all into the mud beneath.

I knew that dendrophage would come in handy, Billy thought.

"Oh, my," said Wyllam Jarneyvore to a hall full of horrified parents. "I wonder how *that* happened?"

ASS—And to this day nobody knows why the floor collapsed?

BtJ—They suspected. They suspected all sorts of things. They even suspected *me* for a time.

ASS—There's ingratitude for you.

BtJ—But then the Mayor's secret accounts accidentally got dumped into the Interstellar Revenue Service's main computer, and he was removed from office. After that nobody ever referred to the floor's ever falling in.

ASS—There are rumors that it was you who caused that "accidental" computer dump. Can you confirm them?

BtJ—I can't answer that question, I'm afraid. Unauthorized computer access is a Quaternity felony. Even in the interests of justice. But let me sketch

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out a hypothetical scenario. Imagine a young man with unusual talents and a strong sense of justice. Under pressure, he learns how to use those talents to make certain . . . beneficial adjustments . . . to society. It's not unreasonable that, flushed with his first success, he might use them again.

ASS—But you can't have citizens taking the Law into their own hands!

BtJ—The Law gets into a great many hands, most of them less safe than those of the average citizen. But there were other motives for our hypothetical young man. He disliked the way self-important people think that nothing really counts unless it gets their blessing.

ASS—That's a strange attitude! But I suppose a child might think that way.

BtJ—Some adults would agree. Take this show of yours. Some people might consider its basic premise to be that nothing's worth doing unless it gets the Alvyn Snergrude Seal of Approval. [*Smiles to show this is intended in jest.*]

ASS—[*Facetiously*] I'm glad this isn't Grover's World, then. It's a long way down, and mud doesn't suit my complexion.

BtJ—No, you'd have to use snow on Wyldhype, it's the only thing around. Who knows what—"

With a creaking sound the roof over Snergrude's head caves in. A small avalanche descends and envelopes him in snow.

BtJ—. . . might happen? Well, folks, it seems that Alvyn is in a heap of trouble. In his absence, let me introduce my next guest, those delightful three-hundred-pound paragons of fragile femininity, Meryltrude Axlegrease and her shovel-swallowing formation team!

Tumultuous applause.

Exit one Joat, in haste.

Fade picture from Emergency Masterboard.

PLEASE DO NOT ADJUST YOUR RECEIVER

NORMAL SERVICE WILL BE RES—

Computer detects, but fails to counteract, external override.

Picture returns.

Close-up of red-faced Alvyn Snergrude being pulled from a heap of snow by three lady-shovel-swallowers.

THIS PROGRAM HAS BEEN BROUGHT TO YOU

AS A PUBLIC SERVICE

BY PRACTICAL JOATS INCORPORATED

Sound of large raspberry.

Fade. ■

● In the world of human thought generally and in physical science particularly, the most fruitful concepts are those to which it is impossible to attach a well-defined meaning.

Hendrick Anthony Kramers

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the reference library

By Tom Easton

This Is the Way the World Ends, James Morrow, Henry Holt & Co., $18.95, 319 pp.
Pioneering the Space Frontier, The Report of the National Commission on Space, Bantam, $14.95, 211 pp.
The Songs of Distant Earth, Arthur C. Clarke, Del Rey/Ballantine, $17.95, 257 pp.
Shards of Honor, Lois McMaster Bujold, Baen Books, $2.95, 313 pp.
The Nimrod Hunt, Charles Sheffield, Baen Books, $3.50, 416 pp.
Highway of Eternity, Clifford D. Simak, Del Rey/Ballantine, $14.95, 291 pp.
The 1986 Annual World's Best SF, Donald A. Wollheim, ed., DAW, $3.50, 303 pp.
Tin Stars, Isaac Asimov, Martin H. Greenberg, and Charles G. Waugh, eds., NAL/Signet, $3.95, 352 pp.
Merlin's Booke, Jane Yolen, Ace, $2.95, 178 pp.
Burning Chrome, William Gibson, Arbor House, $14.95, 200 pp.
Tales of the Quintana Roo, James Tiptree, Jr., Arkham House, $11.95, 101 pp.
The Starry Rift, James Tiptree, Jr., TOR, $14.95, 250 pp.

I have an eight-year-old daughter, Joellen, who is very precious to me. If anything or anyone were to remove her from my life, I would go stark, staring mad. That is one reason why the spectre of nuclear war terrifies me. It is also one reason why James Morrow's superlative **This Is the Way the World Ends** is one of the most moving books I have read in years. The novel also has a nasty bite, and when the blurb-writer calls it the *Alice In Wonderland* of the nuclear age, he (or she) is not wrong at all.

Morrow, who impressed us last with *The Continent of Lies*, now shows us a near-future USA in which deterrence has reached new heights of MADness. The latest rage, huckstered by an Assistant Secretary of Defense, is "scopas" suits, self-contained post-attack survival suits. Supposedly radiation and

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blast proof, they have their own air supply, first-aid kit, weapons, and seeds for planting once things settle down after the holocaust. *Everyone* has one, and the nation is at last civilly defended.

The novel's protagonist is mild, meek George Paxton. His profession, aptly enough, is that of tombstone carver, and he too has a wife and daughter. But he cannot afford a scopas suit for his little girl until a strange woman offers him one for free; all he must do is sign a paper that admits his complicity—by inaction—in the extinction of the human species.

He signs. Who wouldn't? And then the bombs fall. He loses everything and everyone. And then he, and five others, are rescued. The rescuers are the "unadmitted," members of future generations permitted by quantum fluctuations to pop out of the ice of Antarctica. They will never be born, and they resent the foreclosure of their lives. They put the sole six survivors of humanity on trial for crimes against humanity, peace, and the future. Five of the six are certainly guilty; they are that Assistant Secretary of Defense, a general, a TV preacher who advocated ever-greater armament against the heathen, an arms-control negotiator, a weapons designer. Paxton, everyman, is not innocent; he *did* permit the preparations for Armageddon by failing to protest.

What I thought the book's most moving moment was Paxton's reunion with his apparent daughter. Yet the book is very effective in other ways as well. Long lectures in defense of MAD and nuclear deterrence become ludicrous in context. The story's frame, in which Nostradamus, in league with Leonardo, foresees it all, strikes an appropriate note of despair. Paxton's love affair is a perfect exercise in futility. The vulture is the final—and fitting—touch of absurdity.

Spend the money. Buy the book. Read it, weep for our species' folly and potential extinction. Stop being a George Paxton, and do something.

What do I do to escape my own complicity in the potential holocaust? To save my daughter? I lecture to my students. I talk to you. And it is not enough. We need a way to force disarmament on a reluctant government. I think of a taxpayer strike, but that would not work unless it involved some large proportion of the nation's citizens and corporations. Anyone want to try getting *that* act together?

I thought not. So write to the President and Congress. Deny money and votes to any meathead who supports military solutions. Give them to more reasonable candidates.

Ask yourself: Wasn't the purpose of the US Constitution to make of us a "People's Republic"? So call us that. Embrace the Soviets as fellow people who differ in history and philosophy. Admit that the two governments are equally evil or good (aren't they?). Proclaim that we have seen the errors of our ways and swear eternal friendship. Join Gorbachev in his call (this week, as I write this) for an international space program, and insist on funding it with the world's nuclear arms budgets.

If only we *could* do that! Our daughters would both live and have a chance to fulfill the dreams of the National Commission on Space, appointed by President Reagan and Congress in 1985 "to formulate a bold agenda to carry America's civilian space enterprise into the 21st century." Over the next year, the 15-member Commission (including Chuck Yeager, Jeane Kirkpatrick, Neil Armstrong, and Gerard K. O'Neill) held

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public meetings, solicited opinion widely, and put its agenda together. Now, for just $14.95, you can buy a copy of the report as an oversized paperback. It's **Pioneering the Space Frontier: An Exciting Vision of Our Next Fifty Years in Space,** and it's a considerably jazzed up version of your standard government report—slick paper, four-color artwork, sugar-coated upbeat prose, all in the name of communication with the public, of *selling* space. Forgive me if I suspect Madison Avenue had a hand in its production.

Not surprisingly, though it awakens my cynicism, the tone is precisely what you might expect under the Reagan Administration—"America first, and make it pay!" Yet under the politics lies a set of recommendations to gladden the heart of the SF fan. The Commission urges not just a space station, but orbiting spaceports, lunar bases, Earth-Mars cycling spaceships, Mars colonies, and more, and it calls for more money for NASA, more emphasis on long-range planning, more ambition, and more follow-through. The benefits, it says, will come in new scientific knowledge, technological advances, international leadership, new opportunities for individuals and businesses, and sheer inspiration. It even points to the economy of abundance that awaits us in the deeps of space.

The Commission is right, of course. But I suspect its recommendations will go nowhere in these days of deficit anxiety, tight budgets, and government tunnel vision, unless YOU do something. Buy the report, read it, and write the White House, your Senators and Representatives, and NASA. Tell Washington to raise taxes (if necessary). Tell Washington that the best defense is a strong offense, aimed at the problems of nature rather than other nations, and that we should . . .

I said it already. *Push* for the future you want. If you do, maybe the Commission's vision of the next century will turn out to be too conservative.

In a "Bibliographical note," Arthur C. Clarke reveals that his latest—and last?—novel, **The Songs of Distant Earth** began as a short story written in 1957 and published in 1958. In 1979, it became a short movie outline. Now it is a thoroughly satisfying novel.

Not long from now, says Clarke, scientists discover that the reason for the shortfall in solar neutrinos is that the sun is about to go nova. By the mid-third millennium, the first seed-ships are on their way, carrying stocks of frozen human and animal embryos and seeds to the stars. A century later, the seeders carry only DNA codes, with which to reconstruct Earthly life on arrival. In 3109, one reaches Thalassa, an ocean world with three small land masses, and there arises a culture of relaxed competence that reminds one of Polynesia.

In 3500, Earthlings learn how to tap the colossal energies of the vacuum and build starships able to carry millions of corporeal humans. By 3620, when Sol finally blows, a number of these gigantic ships, protected against cosmic radiation and dust by shields of ice, have left Earth. One, the *Magellan,* reaches Thalassa in 3827, its ice badly eroded. Before it can continue to its target world, Sagan Two, a lifeless hell the *Magellan*'s crew plans to terraform to make its own, it must rebuild its shield.

And here the tale begins. Brant is blaming the destruction of his metal fish traps on neighboring islanders when the *Magellan* announces its arrival. The duty crew descends to negotiate for space to build a freezer plant and for

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water to freeze into 600-ton hexagonal bricks for the shield, paying with news of Earth, library updates, new faces. There is new technology, as the *Magellan* provides sensor devices to observe the giant crustaceans that wear fish-trap wire wrapped around their claws as badges of rank, and farm kelp with simple tools. There is even death, for the *Magellan* hoists its bricks into orbit with a long cable (space elevators are passé), and one day a young local, showing off for his girl friend, is on a brick when it rises into vacuum.

Given the disaster the exiles flee, I expected a mood of despair to pervade the book. But it is not there. Clarke, one of our foremost technological optimists, believes that with nearly two millennia in which to absorb the idea, people will orient themselves outward. When they flee, they will look back with regret, grieving for those who died in the conflagration, but their dominant feeling will be one of expectation. He may be right, though I suspect the human animal is less dispassionate and objective than Clarke would have it; our fevers run high in the best of times.

But Clarke is not trying to depict a realistic future. He is standing at an open door and saying, "Behold a new world! Burn your bridges behind you, and come. You will find sanity and prosperity. You will meet strange intelligences in foreign seas. You will find grand goals, and a glorious future."

In the future of *Songs*, disaster, glory, and goals unify our species. People cooperate. They are civilized, and there is no imperialism, no impact of loggerheads, nor even serious rivalries. Brant even steps aside when his wife falls for the ship's Assistant Chief Engineer, Loren Lorenson. Even the one small, tentative mutiny fails to spoil the vision. And the *Magellan* goes on to meet its destiny, leaving the Thalassans to theirs.

I'd love to think Clarke is right in his optimism.

Lois McMaster Bujold's **Shards of Honor** begins as a scientific survey camp is blasted by the forces of militaristic, intrigue-ridden Barrayara. There are only two survivors, the thirtyish commander, Cordelia Naismith, and her botanist, Ensign Dubauer, who had climbed the mountain to collect samples. They see the smoke, return to find the rubble, and are attacked by the Barrayarans. Later, Cordelia awakens to find the Barrayarans gone, except for their commander, Aral Vorkosigan, renowned as a butcher but marooned by mutineers in his crew. Dubauer is crippled. Together, the three must make their way to the Barrayaran cache, overpower the mutineers, and return home, Aral to lead a war, Cordelia to oppose him. Tragically, despite the poor start to their relationship, they fall in love before their fates separate them. Fortunately—and predictably—love conquers all, and Cordelia and Aral end in each other's arms.

Recent Baen books have been dominated by the romance of war, all action and blood and death, the pornography of violence. *Shards* does a lot to redeem that emerging stereotype by focusing on the *other* romance of war, the separation of lovers by politics and human depravity and their reunion despite it all. Yet the tale is not quite so simple, despite its conventionality and predictability. Bujold has a nice hand with the complications, from Aral's conflict between his own view of honor and his culture's, to the sadistic Admiral Vorrutyer, to Cordelia's rejection of government exploitation of her experiences, to the psy-

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chologist who tries to "treat" Cordelia's love for Aral.

There are defects, of course. That psychologist is remarkably and stereotypically obtuse. Most subsidiary characters are so thin they are transparent. And Bujold forces her happy ending well beyond what seems to me necessary. But, all in all, *Shards* is a worthy effort, and worth reading for any fan of SF romance.

Charles Sheffield's work is always a pleasure to read, and his **The Nimrod Hunt** is no exception. Set in a time of human expansion, when distant ships carry matter transmitter (Mattin Link) portals ten light years farther out every century, it seems a tale of paranoia. At a remote research station, workers are creating the Morgan Constructs, manufactured scouts and explorers equipped by bio- and physical engineering to resist destruction. Events begin to move when the 17 Constructs go berserk, destroy the researchers and their security-force guards, and escape by Link to 17 unknown locations. Security honchos Luther Brachis and Esro Mondrian must find and destroy them, but only by using teams composed of one human, one Tinker Composite (a swarm of insectoid beings), a Pipe-Rilla, and an Angel (a plant-crystal symbiosis). The task seems impossible, for the alien members of the Stellar Group are incapable of human-type initiative and violence.

Naturally, success is inevitable, if not quite in the terms we are initially lead to expect. And what yields that success is often fascinating. Brachis and Mondrian are rivals forced to cooperate, and much of the story focuses on them. We see Mondrian's obsession with unraveling the dark secrets of his soul, even to the point of seeking out the outlawed Freud-hoppers (Fr'oppers) of Earth. We see Brachis's exploitation of the illegal art of genetic engineering to create false Morgan Constructs for training purposes, his destruction of the engineer who helps him, and the engineer's attempts at revenge. We see Godiva Bird, courtesan supreme, who ensnares Brachis. We see the Adestis ("You are here!") holiday device, which puts human minds in inch-high simulacra to fight termites, scorpions, and trap-door spiders. We see the Tolkov Stimulator, which can *sometimes*, after long and painful effort, boost a brain's power, and its use on Chan Dalton, Earthling retardate, who will eventually become something of a superhero. We see a degraded Earth of cheap royalty and enslaved commoners, a backwater of interstellar civilization.

We see also the very term "Nimrod," which *Genesis* uses to mean a mighty hunter beloved of the Lord. It first appears over halfway through the book, refering to a Morgan Construct, discovered on the jungle world of Travancore. But that is obviously misleading, for the Construct is prey, not predator. "Nimrod" is really a multileveled term, applying in different degrees to Mondrian, humanity as a whole, hero Chan, and the entity that appears at the tale's end.

Perhaps oddly, the story works even though its many conflicts seem pale and lifeless. Sheffield's focus is on technical marvels, and his theme is a paean to cooperation of human and alien, Earthling and spacer, machine and biology. It is this theme, too often neglected by our many shoot-'em-up artistes, that justifies Sheffield's attention to Mondrian's neurosis and Brachis's love affair far beyond the needs of characterization or plot. It drives both plot and conclusion, and it makes *The Nimrod Hunt* repay the reader well. Unfortu-

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nately, I suspect it will limit the tale's appeal.

In Cliff Simak's latest, **Highway of Eternity,** Jay Corcoran's weird visual ability reveals a strange box on the outside of a building about to be torn down. He summons old friend Tom Boone, who can step around corners, and together they step into the box, which proves to be a time machine that whisks them to 1745 England, where a family of far-future refugees is hiding from the aliens who, in their time, are discorporeating all humans. Shortly, a monstrous robot appears, all flee into various ages, and the hunt for each other and for answers is on.

It's patent Simak. The characters are all well-meaning blokes, there are folksy robots and elder intelligences ready to take a hand, and the plot threads do come together in the end. And the reader enjoys a pleasant sojourn in a distinguished imagination, a very mellow read. I loved the time-space traveling net, the highway of the title, the hints of cosmic significance, the wolf that befriends Boone 50,000 years ago.

But then, I do love Simak. Some people find his folksiness irritating, and they will object to the lack of any real unifying theme in *Highway*. That lack does, in fact, make the novel Simak's weakest in many years. But I still enjoyed it.

Don Wollheim's latest is **The 1986 Annual World's Best SF,** gathering ten dollops of 1985 cream, American only. It gives us Brian Clarke's "Earthgate," from this magazine; Ian Watson's "On the Dream Channel Panel," a playful saga of wish-fulfillment; "The Gods of Mars," by Dozois, Dann, and Swanwick, on Burroughs and consensual reality; Lucius Shepard's "The Jaguar Hunter"; Silverberg's "Sailing to Byzantium"; Jayge Carr's "Webrider"; and Ellison's "With Virgil Oddum at the East Pole," a Medea yarn. C. J. Cherryh's "Pots" is a much more satisfying excursion into archeology than Connie Willis's "The Curse of Kings," and Fred Pohl's "Fermi and Frost" may be the best item in the book, a genuinely moving evocation of the holocaust we fear.

As usual, there is only some overlap with the Dozois *Best*, which remains the one to buy when you're having only one. It too gives you the Pohl, the Shepard, and the Silverberg, and to my mind most of its others top the rest of Wollheim's picks.

Tin Stars, edited by Asimov, Greenberg, and Waugh, is the fifth in the Good Doctor's Wonderful World of SF anthology series, and it's a good one. The macguffin is robot or computer cops, and we get Goulart, Niven, Wellen, Harrison, Asimov, Ellison and Bova (with "Brillo"—metal fuzz), Donaldson, Sheckley, Slesar (the nasty, nasty "Examination Day"), Wismer, Tabakow, and more. One of my favorites is Christopher Anvil's "The King's Legions," from these pages circa 1967, in which three idealistic opportunists find that their intelligent spaceship is really a recruiter for the Patrol (it's too bad the editors couldn't fit in the tale's prequels).

What makes this anthology better than many theme anthologies is the wealth of variety computer cops can take, from literal police-surrogates to traffic control computers and testing machines. The result is a satisfying variety of story types, which we seem less likely to get in a book full of unicorns or dragons.

* * *

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I am not sure Jane Yolen knows how to write a bad story. In **Merlin's Booke,** she assembles a dozen excellent poems and stories dealing with various aspects of Merlin's life. As she says herself, "the only thing to link these stories is the figure of Merlin and he is a different character in each tale." On the fabric of what little history has to say about Merlin, she has embroidered alternate fancies, each one of which evokes the spirit of the Arthurian mythos but also expresses Yolen's own clear-eyed vision. I liked best "The Sword and the Stone," in which practicality bemuses magic. Another favorite is "Epitaph," in which the shoe is on the other foot. Modern scientists find a tomb marked as Merlin's, with a mummy and a small chest that may contain the mage's heart. When they open the chest at a press conference, the story ends omen-ously and we remember that Merlin and Arthur are due to return when the world needs them most.

If you have any taste for fantasy or Arthur's Age, don't miss.

William Gibson, despite what Bruce Sterling says about him in the preface to **Burning Chrome,** is not the greatest thing to come down the pike since Heinlein. He's good, yes. But his prose is not "hi-tech electric poetry" and his vision, imagination, and story-telling skills are by no means unique. What he has going for him is the ability to see how new technologies—electronic and chemical—may affect the underbelly of civilization. He gives us datathieves, neuropeptide drugs, plugged-in, drug-boosted game freaks, the paraphernalia of the new cyberpunk idiom, and he does it mostly with the sort of clear, workmanlike prose we are used to seeing in SF. The stories themselves owe a great deal to Gibson's predecessors in SF and spy fiction.

He's good, and *Burning Chrome* is a good collection to buy. Yet the collection lets us see what we miss when we are raving about the single story that seems so marvelously pyrotechnical when we read it in a magazine. Gibson forgets that the impact of technology is limited—people today live much as did their great-grandparents; the differences are almost entirely in the *trimmings* of their lives, the appliances in the kitchen, the tools in the office and shop, and in the statistics of occupations (for instance, there are many fewer farmers, and farms are bigger, but farmers still keep long hours and though they have more machinery, they use it do the same things). He, like many SF writers, thus misrepresents the possible future.

Perhaps it would be instructive to compare civilization with the Catholic church: The ritual, the personnel, the beliefs change very slowly, only over centuries; change enters quickly only on the secular side, in the means of communication, travel, and record-keeping, in the nonessentials. People are far more conservative than Gibson presumes.

To my mind, Gibson does his best work when he drops that presumption. My favorite of the stories in *Burning Chrome* is "Dogfight," by Gibson and Michael Swanwick, which shows people more realistically. It gives us a fighter ace, burned out by military technology, living for his victories in brain-manipulated holographic biplane fights. It gives us a student, quite naturally obsessed with the new technology she is learning. It gives us an opportunistic shoplifter exiled from Washington, DC, to intercept the student's and the ace's lives, and finally a poignant, hurtful ending. As usual with Gibson, there is no hero; as is not usual, there is a very

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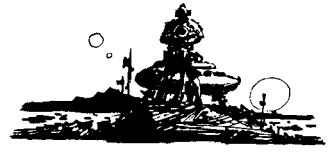
human touch, which I suspect is due more to Swanwick.

Dr. Alice B. (aka Raccoona) Sheldon (aka James Tiptree, Jr.) is well known for her many superlative SF stories, including several set on the Yucatan Peninsula of Mayan Mexico. Three of those stories appear in Tiptree's **Tales of the Quintana Roo**: "What Came Ashore at Lirios" (from *Asimov's*), "The Boy Who Waterskied to Forever," and "Beyond the Dead Reef." The second is a tale of time travel via waterski and serendipity. The others express an environmentalist's dream of the sea's yearning for revenge against the humans who have despoiled and polluted its waters and reefs. All are memorable tales, and the book, evocatively illustrated by Glennray Tutor, is well worth adding to any collection.

Tiptree gives us three more tales (without credits), the excellent "The Only Neat Thing to Do," in which a Podkayne-type (precocious) girl takes off for the Rift in her new starship, finds a species of strange and dangerous aliens, and must save the human realm; the only slightly less excellent "Good Night, Sweethearts," in which a solitary driver of an intersteller towtruck must save his one-time darling, and the young clone of her clone, from pirates; and "Collision," in which a naive crew of explorers finds the Ziello Harmony and must convince the aliens of human trustworthiness and peacefulness despite their bitter experiences with the Black Worlder pirates. I am half inclined to call "Collision" the best of the three, but it is marred for me by Tiptree's strange Ziellan biology; they breathe our air, with added carbon dioxide, and they respond to human drugs, but water is corrosive anathema, even though it rains on their world.

Tiptree and TOR pretend that **The Starry Rift** is a novel by giving the stories a frame set far in their future. University students visit the library to learn something of the human emergence into galactic civilization, and the genial librarian has dug out these three "gems." It fails to convince, the more so because it echoes a hundred similar pretences. I preferred *Tales of the Quintana Roo*, for though it offers fewer pages per dollar, it is a more honest book. It lets its stories stand alone. ■



● Eventually, no matter what we do there'll be artificial intelligence with independent goals. It's very hard to have a machine that's a million times smarter than you as your slave.

Edward Fredkin

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brass tacks

Dear Dr. Schmidt:

Legalize the duel. Remove restrictions on the use of drugs. No speed limit on the interstates. My rights over all.

In our society, the rights of the individual are defended fiercely. Your editorial in the June 1986 issue and an earlier one on the issue of mandatory seatbelt laws attest to your strongly held beliefs. However, you fail to consider the costs of maintaining such attitudes.

Alexis de Tocqueville, in his great study of democracy in America, foresaw that the greatest threat to the survival of American democracy was the emphasis on individualism. Robert Belah has studied modern American society and has arrived at the same conclusion, except much that de Tocqueville foresaw has come to pass. Far from becoming a restrictive society, individual rights have expanded, suspicion of government has increased, and individuals are becoming oblivious to everyone outside their immediate circle of family and friends. The disintegration of society is all about, if you care to look.

Individualism and the lack of social responsibility that it engenders is the greatest danger to our society. The threat of communist takeover comes in a distant, probably invisible, second. I find it almost hilarious to imagine members of the L5 society (good people, all) actually living in a space habitat where their rights to act as individuals would have to be subsumed in the needs of a truly closed society. How would they survive without their .38 Magnums?

Perhaps survival of American-style democracy is impossible in a country where the cult of the individual overrides all else. I hope not; it has provided us all with a heady experience.

ROBERT B. MOLER

Catharpin, VA

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Individualism and social responsibility are not incompatible, and you have never *read an unqualified "my rights over all" philosophy in this magazine.*

And how many L5 members do you know who are dependent on, or even have, .38 Magnums? You hardly strengthen your case by resorting to ridiculous and insupportable stereotypes.

Dear Dr. Schmidt:

I come from the camp best described as anti-abortionist. I would even like to see the law changed and abortion made illegal, again. Be that as it may, I couldn't agree with you stronger about these "non-violent bombings." They are absolutely illegal and turning aside our heads from the fact that the individuals doing them are not prosecuted is indeed a tremendous threat to our freedom, regardless of our personal beliefs on this issue.

However, the thrust of your article was the issue of endangered freedom, as I understood it. Therefore, I was more than a bit surprised to find the following statement in your editorial. In speaking out against the activities of the active anti-abortion groups, you included the following: " . . . and setting up their own propaganda centers disguised as abortion clinics to entice victims inside and trick them into listening." As much as you obviously dislike these centers, which is an unmistakable conclusion, from your use of such connotative words as "propaganda," "disguised," "entice," "victims," and "trick," if the thrust of your editorial was, indeed, that the responsibility of living in a free country involves not turning aside when that freedom is threatened, then in addition to raising our voices demanding that these anti-abortionists be punished for their totally illegal bombings, you should at least not raise your voice against these "propaganda centers." If freedom is the issue, you should have rightly been expected to have spoken *for* them, in fact, and not have turned aside from their existence by merely deleting that part of your condemnation of the ongoing activities of various anti-abortion groups. . . .

Aside from recognizing that freedom demands that these centers of alternative counseling have a right to exist for *freedom's very sake*, they perform a very healthy function. For some, they do open the way to alternative solutions. Others feel even firmer in handling a pregnancy that is a more serious problem for them than abortion. Whether or not they are successful in persuading a woman to change her mind, the less lightly a woman makes this extremely difficult choice the happier she tends to be, and the more able she is to handle her conscience down through the years. Nature allows only a very short time to make what is a gravely important decision for most of us. And it is completely irrevocable. Even to the woman who feels she has made up her mind, and is "tricked" at the last into entering one of these places, if such is the case, her conscience is that much freer in later years that her decision to abort was the only one she felt she could make at that time. I believe help is also offered along with the opposing view about what she is about to do. In any case, the more serious consideration a woman gives to this, the easier she finds it to accept and live with her choice. . . .

The bombings are a clear issue.

So is the right of anti-abortion clinics to exist within the law.

If we are to meet the responsibilities of freedom, people on both sides of the abortion issue must share in their con-

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demnation of the first *and* share in their support of this last.

G. ANTOINETTE O'HEERON
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Words like "disguised" and "trick" are not just *"connotative," but denotative as well. My condemnation was not of the anti-abortion centers' expressing their views, but of their use of deceit to get people to listen. If you tell people a building is one thing to get them inside, when it's really something entirely different, that's deceit, pure and simple, and connotations have nothing to do with it—and that's exactly the kind of behavior that was described in the news stories I saw.*

And while some of the centers' activities are probably legally protected, the word "rude" still seems applicable and understated. I'm all for freedom of speech—but not shouting in the ears of people who choose not to listen to you.

Dear Dr. Schmidt

Recieved my July issue a few days ago and felt I had to respond to your editorial.

First, to make a point of the legality of abortions is begging the question! History is full of actions that were contrary to the laws of the time, which none the less proved to be morally correct, particularly in hindsight. The same may be said of actions that were "lawful" and still were condemned by others at the time or in hindsight. A couple of examples: the "Indians" at the Boston Tea Party were certainly law breakers, as were the Minutemen. On the other hand, the guards and oven operators et al at Dachau and Bergen-Belsen were not. Certainly, as civilized beings, we are bound by a higher moral code. Something that is "legal" is not necessarily "lawful"!

Second, the phrase "change the entire course of a woman's life" etc. is somewhat of an overstatement! For the sake of round numbers, let us suppose a year of a woman's life per baby. That is hardly her "entire life." I imagine you meant the child's growing up and all that, but this is unlikely to be the case for an unwanted child. Adoption agencies are crying for children; if you don't believe me, try to adopt one. Further, an adopted child is hardly likely to be unwelcome, considering the hassle you have to go through to get one!

DONALD L. PARSON
Baudette, MN

Dear Stanley Schmidt:

Let me state, up front, that I feel much the same way you do about abortion. " . . . a rather distasteful last resort." My problem is not with your belief, but your arguments.

At one point you state that it is not a scientific belief that a fetus has rights. This is, as you note, a matter of philosophy and definition. Science may not be the best authority here, so why are you bringing it in on only one side of the problem?

You seem to give great weight to the law. Law has been on the side of slavery, genocide, and human sacrifice in different times and cultures. Would you consider those who protested violently against Hitler "rude"?

I am against people's spewing their holy tripe on these women who are often young and facing their greatest personal conflicts. I am almost an anarchist. I think the less law the better, Heinlein's "free citizens" and all.

What I hope for from people in your position, who come out on the same side of an issue as I am, is arguments good enough to make me feel comfortable.

Wherein lies our humanity?

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CHARLES E. KELKSON
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You're quite right that law has in some times and places supported slavery, genocide, and human sacrifice. Some maintain that abortion is of the same ilk; others claim there is a fundamental difference because the three practices you name (which they, too, would oppose) have as their victims people who are unarguably fully human beings. However, it's also true that past perpetrators of slavery and genocide defended their actions by saying their victims were not *fully human. Most of us now agree that they were wrong; how history will judge the present controversy is still up in the air (and probably subject to fluctuations over long periods). About all we can agree on now is that the humanity of the victims is still being seriously debated only in the case of abortion—but that one* is *still being seriously debated.*

The issue of when laws should be enforced or obeyed is indeed a thorny one—and I don't think it has any nice, simple answers. See this month's editorial. . . .

Dear Dr. Schmidt,

I agree and disagree with your editorial on abortion. I agree that religious liberty and the plurality of religions in America make it imperative that we respect each other's freedom and rights.

In such a serious thing as abortion, the examples you give of when you would permit an abortion seem frivolous and unworthy. If science cannot prove that two cells coming together (sperm and ovum) form human life, neither can it disprove it. What else is the zygote or fetus going to be—canine? feline? human!

However, since I believe that abortion is morally evil, even intrinsically evil, I have to follow my conscience and do all I can, legally and reasonably, to share this conviction with my fellow citizens, and work, within the law, to make abortion illegal.

But again, I strongly agree with you that violence must not be used nor some sort of "holy war" or crusade be preached. I really think that reason will finally prevail in this important issue.

CHARLES DOLLEN
Poway, CA

The key phrase is "going to be." Few, if any, deny that a fetus is alive or that it will become *human if it lives long enough. But many consider it to be something* in process of happening *rather than something which* has *happened.*

Dear Stan,

I really enjoy and appreciate the magazine and have decided to be a regular letter writer. I know you like to get feedback from the reader side of the *Analog* family and I feel its about time I began to do some responding. I have been a regular reader since December 1979 and feel the book just keeps getting better. (Though I do miss Jerry and Spider still.)

Now, just a few comments about your "Unholy War" editorial of July 1986. First, most of us who are "pro-life" despise the abortion-clinic bombings as much as you. I know you aren't falling into the fallacy of concluding that the pro-life position must be wrong because some people who hold that postion are acting irresponsibly in the name of that position. Of course your editorial was only about those who DO act irresponsibly. But many do fall into that fallacy. It's one you have dealt with before in another context when you talked about "crackpots." It is conceivable that

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those people we find most annoying and rude in their behavior might be right in their ideas.

Secondly I want to disagree with you that the pro-life position is one held because of religious beliefs. (It is ironic that I say this, isn't it?) Most believers I know who are pro-life feel that because they are believers they are required to protect the innocent and defend the helpless. But their conclusion that the unborn are innocent and helpless human beings is not one of faith. The faith comes in after the realization that a fetus is a human being. The issue of conception may be a religious one, but the issue of abortion has to do only with attached fetuses some weeks old which have a well developed, recognizably human, body.

It seems to me if all women had invisible abdomens and wombs so we could see the living fetus within, then all of us would recognize that we are talking about human beings. I remember a statement in *The Moon is a Harsh Mistress* that went something like—"Your right to swing your fist stops at the end of my nose!" What you say about why extreme pro-lifers mustn't be allowed to bomb clinics is also a valid argument why in most cases abortions should not be allowed.

I myself take a hopeful view of the problem. I think in the not too distant future medical technology will advance to the place that a four week pregnant woman can abort her pregnancy without killing the fetus, which will be able to survive and grow thanks to improved technology.

PASTOR RANDY KEEFE

Naches, WA

Dear Stanley,

I found Rick Cook's "The Long Stern Chase" quite stimulating in a number of ways, especially if the ideas are developed further. For example, as a cursorial species we have quite a few short term, non-dogged tendencies. Television commercials, with their training of audiences' attention spans to shorter and shorter lengths, are carrying us away from the long term, marathon attention spans of the cursorial hunters, away from all the survival characteristics that are the legacy of cursorial civilization—science, institutions, laws are all efforts at the long term, derived from the focused, awareness-producing tendency of a cursorial hunter's ability to concentrate.

As a species, we have too many non-cursorial, short attention span tendencies in us for a goal directed hunter; too much short-term thinking to be truly successful. Too much Eloi for the Morlock; too much unconscious for the conscious.

Cook's piece suggests, in fact, how self-awareness might have been born. Hunters went out and had to concentrate on the long hunt; those who could do this longest with the most imagination survived, and one day their offspring made the slow transition to self-consciousness—focused attention span.

But the non-cursorial short-termers are still with us, in all of us to a degree. Long attention span is a high ground we still have to take with difficulty. We pass things on to future generations, in our cursorial, goal directed way, but too many people still have to learn everything for themselves. As I said, we're still too non-cursorial to be truly successful long term hunters.

Maybe as a species what we really need is an agent!

GEORGE ZEBROWSKI ■

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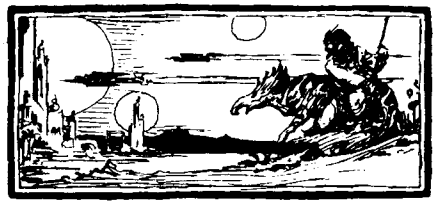

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a calendar of analog upcoming events

2-4 January
EVECON 4 at Washington, D.C. Registration—$15 in advance, $20 at the door. Info: Evecon, c/o FanTek, Box 128, Aberdeen MD 21001.

2-4 January
UNIVERSE 87 (southern California SF conference) at the Airport Hilton & Towers, Los Angeles, Calif. Guest of Honor—Jerry Pournelle. Adventure game tournaments in addition to the usual SF. Registration—$16.50 until 13 December 1986, $20 at the door. Info: UNIVERSE 87, Box 2577, Anaheim CA 92804.

9-11 January
HEXACON 9 (central Pennsylvania SF conference) at Brunswick Motor Inn, Lancaster, Penna. Guest of Honor—Christopher Stasheff, Artist Guest of Honor—Barbi Johnson. Registration—$10 until 22 December, $15 at the door. Info: Hexacon, c/o Bruce&Flo Newrock, Box 270-A, RD2, Flemington NJ 08822.

16-18 January
CHATTACON XII (Chattanooga area SF conference) at Read House, Chattanooga, Tenn. Guests of Honor—Larry Niven and Christopher Stasheff, Artist Guest of Honor—David A. Cherry, Fan Artist Guest of Honor—Beth Willinger, Fan Guest of Honor—Walt Baric, MC—Wilson Tucker. Info: Chattacon XII, Box 921, Hixson TN 37343.

16-18 January
ESOTERICON '87 (Northern New Jersey SF conference) at Sheraton, Hasbrouck Heights, N.J. Registration—$25 until 31 December, $35 at the door. Info: Esotericon '87, Box 22775, Newark NJ 07102. (201) 672-9244.

23-25 January
STARK RAVING CONFUSION (Ann Arbor area SF conference) at the Plymouth Hilton, Plymouth, Mich. Guest of Honor—Katherine Kurtz, Fan Guest of Honor—Elizabeth Pearse, Art Guest of Honor—Erin McKee, TM—Bob Passovoy. Registration—$14 until 1 January 1987, $16 thereafter. Info: AASFA/Stilyagi, Box 8284, Ann Arbor MI 48107.

31 January—1 February
CHIMERACON IV (North Carolina SF conference) at U.N.C. Student Union, Chapel Hill, N.C. Guest of Honor—Alan Wold. Registration—$8 in advance, $10 at the door. Tournament gaming, variety show, workshops. Info: ChimeraCon 4, Estes Park, Apt 2-K, Carrboro NC 27510.

27 August-2 September
CONSPIRACY '87 (45th World Science Fiction Convention) at Metropole Hotel & Conference Centre, Brighton, U.K. Guests of Honor—Alfred Bester, Doris Lessing; Fan Guests of Honor—Joyce and Ken Slater; Artist Guest of Honor—Jim Burn Special Fan Guest—David Langford TM—Brian Aldiss Registration—Attending (until 30 September 1986) £25, $40, $A50; Supporting £10, $15, $A20; Join now and get to nominate and vote for the Hugo awards and the John W. Campbell Award for Best New Writer. Info: ConSpiracy '87, Box 43, Cambridge CB1 3JJ, England, U.K. OR Bill & Mary Burns, 23 Kensington Court, Hempstead NY 11550 OR Justin Achroyd, GPO Box 2708X, Melbourne, Vic. 3001 Australia.

3-6 September
CACTUSCON (North American SF conference) at Hilton, Hyatt Regency, Convention Center, Phoenix, Ariz. Guest of Honor—Hal Clement, Fan Guest of Honor—Marjii Ellers. Registration—$15 supporting; $30 attending until 15 September 1986. Info: CactusCon, Box 27201, Tempe AZ 85282. (602) 968-5673.

—Anthony Lewis

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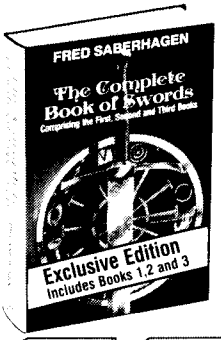

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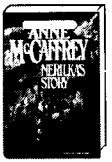

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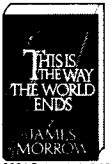

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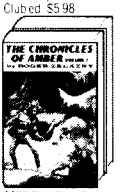

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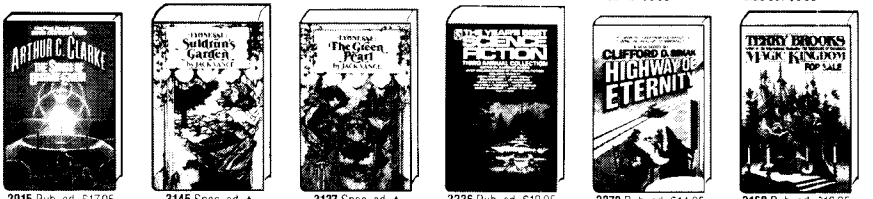

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